PRINCIPES

Journal of The Palm Society

April, 1963
Vol. 7, No. 2

THE PALM SOCIETY

A non-profit corporation primarily engaged in the study of the palm family in all its aspects throughout the world. Membership is open to all persons interested in the family. Dues are $10.00 per annum payable in May. Requests for information about membership or for general information about the Society should be addressed to the Secretary.

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PRINCIPES

JOURNAL OF THE PALM SOCIETY

An illustrated quarterly devoted to information about palms published in January, April, July, and October, and sent free to members of The Palm Society

EDITOR: Harold E. Moore, Jr.

EDITORIAL BOARD:
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Manuscript for PRINCIPES, including legends for figures and photographs, must be typed double-spaced on one side of 8½ x 11 bond paper and addressed to the Editor at Bailey Hortorium, Mann Library, Cornell University, Ithaca, New York, for receipt not later than 45 days before date of publication. Authors of one page or more of print will receive six copies of the issue in which their article appears. Additional copies or reprints can be furnished only at cost and by advance arrangement.

Contents for April

Cover Picture

A toddy gatherer in Ceylon walks the coir-rope catwalks between tapping and gathering operations. Cover and photographs on pages 70-79 by W. H. Hodge.

NEWS OF THE SOCIETY

The International Palm Year

Due to the unexpected delay in getting January PRINCIPES off the press, it may be necessary to postpone for three months the official start of the IPY. Dr. Tomlinson reports very good response to his suggestion about studying and keeping records on palm growth; the reply postcards have been coming in at a rate of two a day, which he considers most encouraging. Of course, there has not yet been time to hear from foreign members, but we hope for many replies from them, also. Dr. Tomlinson's article on procedures for measuring palm growth rates appears in this issue. When our readers see how really simple the method is, perhaps more will be encouraged to help with this important source of information on palm characteristics.

Although the official date may be postponed for a few weeks, it is *not* necessary to wait for a particular date on which to begin measuring and making notes. Spring should be a very good time to make a start, so as soon as you finish reading the article, why not go out and get going? This should be a very interesting project, as well as valuable from an information standpoint.

Cold Weather Damage

Letters are coming in from members in various parts of the world, telling about the damage incurred by their palms during this almost unprecedented winter. It is still too soon to know what the permanent damage will be; several months must pass before we can be sure which palms are dead and which may grow once more. We hope that many members will take the time to report on the condition of their palms, as this information can be preserved and serve as a record for future use.

Seed Bank

Mid-winter is not a very good time for sending out palm seeds; some members have asked that they not be sent during the cold months, as germination seems more difficult then. Moreover, fewer palms mature seeds during the cooler weather, and your "suppliers" (Nat De Leon and myself) are busier than usual during the Florida winter season.

Mr. William L. Manley, of Atlanta, Georgia, an organ manufacturer by profession, has, however, done a tremendous job for the Society and its seed-searchers by gathering about two bushels of seeds of *Trachycarpus Fortunei* from trees in his area, and shipping thousands of them to members who requested them. Commercial growers who hope for a strain of even hardier windmill palms have ordered the seeds in quantity, while amateurs have been satisfied with 30 to 50 seeds. Mr. Manley has turned over all of the proceeds of the sale of these palm seeds to your Society, and has even refused to be repaid for the expenses of shipping. Hats off, and a rousing cheer for W. D. Manley, of Atlanta, Georgia! P.S. He still has quite a lot of seeds, which he will send to those who want them at our usual rates.

Activities of Local Groups

Taking a leaf from the book of the Californians, the South Florida Group is going in for trips rather than evening meetings this spring. On March 10th a large group met at the U. S. Plant Introduction Station, Chapman Field, south of Miami, where we were hosts of Dr. Murray Gaskins, director of the Station, and Mr. H. F. Loomis, past director. We were guided through a part of the palm plantings seldom visited, where we saw many of the less-well-known palms and heard a first-hand report on their history from Mr. Loomis, who has known them well since 1931.

In April, Mrs. Alvin R. Jennings has graciously offered her famous estate for a "ramble" and picnic. Plans are being made for trips to Dr. Lawrence M. Simonson's garden at Lantana, to Key West and Naples, Florida, on future dates.

A letter enclosed with this number tells you some exciting news about the California group's plans.

LUCITA H. WAIT

Measuring Growth Rates in Palms*

P. B. TOMLINSON
Fairchild Tropical Garden, Miami 56, Florida

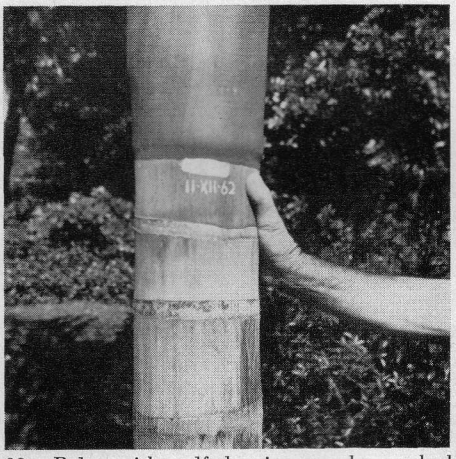
The growth rate of a palm can be measured by estimating the number of leaves it produces in a given period. Each palm stem ends in a leafy crown within which leaves are produced singly in succession. The early stages of leaf development are not visible because the youngest leaves are enclosed and concealed by enveloping older leaves. Each leaf becomes visible as a slender spike growing from the center of the crown with the various parts of the future blade closely folded together. The spike elongates and the blade then expands quite quickly and the leaf is mature. The length of time each leaf persists in the leafy crown varies for different palms and for many it is rather indefinite. As a leaf becomes older it is displaced from the center of the crown by younger leaves. It may gradually dry and decay and its shrivelled remains may persist. On the other hand many palms lose their leaves in a precise way, the whole leaf falling as a single unit. These palms are said to have self-cleaning trunks and probably the most familiar example is the royal palm (*Roystonea*). Other common examples are *Areca*, *Ptychosperma*, *Veitchia* and other members of the arecoid group.

The rate at which new leaves are produced can be determined by tagging plants and keeping them under observation for long periods. Marking can be done without injuring the palm in any way. It can be done inconspicuously so that a palm, for example in a botanic garden, is not made an unsightly object. Also if done inconspicuously it does not attract the attention of curious and destructive animals, like monkeys and small boys.

Two methods have been used at Fairchild Garden for tagging palms, but no doubt others could be devised.

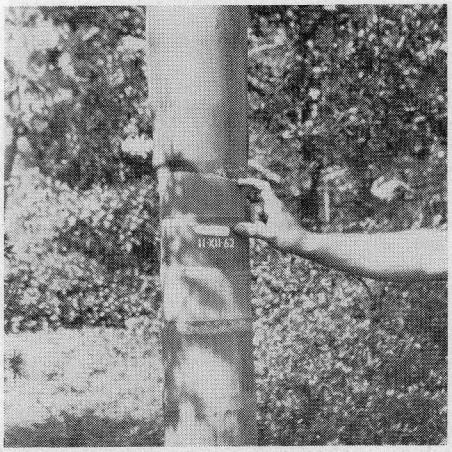
Methods for Self-Cleaning Palms

These are easily marked with paint, on the stem just below the tubular base of the oldest leaf (Fig. 32). It may be necessary to rub off a little wax or scurf from the stem before the paint can be applied. Subsequently as successive leaves fall, their original position is indicated by the circular scars they leave on the stem. Thus after a period it is easy to count the number of leaves lost since the original mark was made (Figs. 33,



32. Palm with self-cleaning trunk, marked December 11, 1962.

*These notes are intended for the guidance of participants in a proposed International Palm Year.



33. Same palm as in Figure 32, March 11, 1963.

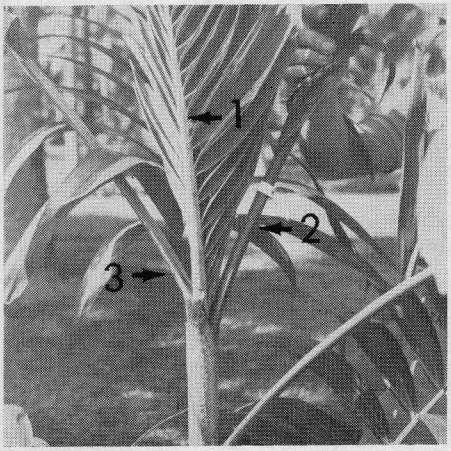
34). The paint mark may have to be retouched from time to time.

Of course this method actually measures the number of old leaves lost rather than the number of new leaves produced. This does not matter if new leaves are produced at the same rate that they are lost, which must be true over a long period, but is certainly not true over a short period. In a recent cold spell at Fairchild Garden some small arecoid palms lost several leaves in rapid succession. Leaf loss was accelerated, the palms certainly were not growing faster. This is one reason why records must be kept on such palms for at least a season.

34. Another palm marked December 11, 1962, and photographed March 11, 1963.

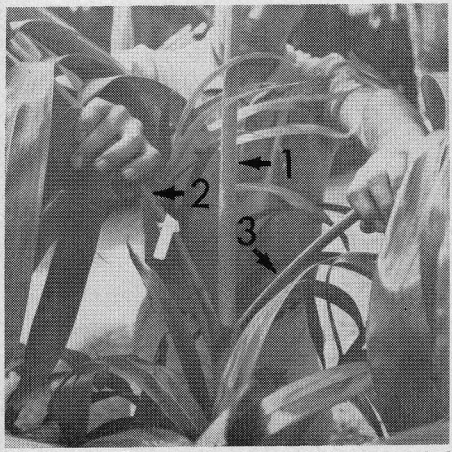
Methods for Other Palms

Careful examination of the leafy crown will reveal the youngest leaf with a fully expanded blade. There may be one or more younger, unexpanded leaves which may be partly visible, but these can be ignored. Tagging is done by firmly tying a piece of colored plastic tape to the petiole, just below the blade, of the youngest leaf with a fully expanded blade (Figs. 35-37). The date of tagging may be written on the tape, although this

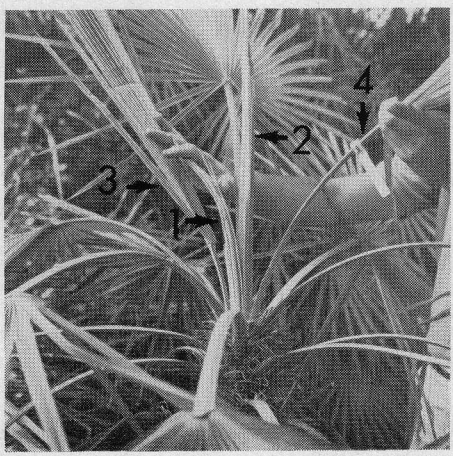


35. Leafy crown with youngest fully expanded leaf tagged.

is not essential. As the tagged leaf is displaced from the center of the crown by younger leaves a count can be kept of the number of new leaves produced. This may be rather more difficult than the description implies, since it is often not easy to recognize the age sequence in a group of congested leaves. A casual glance is not enough, the leafy crown must be examined very carefully. If great difficulty is experienced in distinguishing leaves of successive ages, the one certain method is to tag each new leaf as it becomes fully expanded. Rather more effort than is expected of the ob-



36. Leafy crown with youngest fully expanded leaf tagged.



37. Leafy crown with youngest fully expanded leaf tagged.

server is needed to do this, since a constant watch on the palm must be kept, but the results cannot be in doubt.

Records

After initial tagging, little effort is needed to make and keep records. Observations are best made regularly and three-monthly intervals are recommended. For the palms marked at Fairchild Garden, records for each palm under observation have been kept on a single 3 x 5 inch filing card. Information about the palm appears on one side, the actual measurements on the other (Figs. 38, 39). Most of this information is incidental to the direct measurements and in case of doubt should be omitted, rather than guessed at. Some detailed notes explain the kind of facts needed to be included on the cards.

Scientific name. If this is not known for certain an attempt can be made by me to do this from a good photograph.

Date of planting and age. The age of the palm from seed is required, if possible, and not the period that the palm has been planted out.

Locality. Whether in cultivation as an exotic or a wild palm in a natural habitat.

Soil type. Only very general notes are required, such as whether the soil is well-drained or not; clay, sand, muck or rock; acid or alkaline, although detailed and accurate information if it is known would be very valuable.

Total height. An approximate estimate is sufficient.

Length of visible trunk. Measured as accurately as possible, although for palms without self-cleaning trunks only an approximation is possible.

Diameter at breast height. This can only be given for well-grown palms with at least 3 ft. 6 in. of visible trunk.

Flowering conditions. If the palm has achieved a flowering condition, evidence for this will be found in the presence of young unexpanded inflorescences, or the remains of old ones even though there may be no open flowers at the time of tagging.

Presentation of Information

A suggested layout is shown in Fig. 39. Counts should be made at intervals of exactly three months from the time of first tagging. Otherwise the recording date should be noted. Measurements should continue for at least a year, but by taking records at shorter intervals an

estimate will be gained of periodicity of leaf production. Thus it will be possible to decide if leaves appear more abundantly in one season than in another. Cumulative totals only should be taken. Also in Fig. 39, space is left for records of flowering (open flowers) and fruiting (ripe fruits) which may be added if desired. Little extra effort is needed to make these records on palms which are regularly surveyed. In the cards for palms at Fairchild Garden these records are taken at the same intervals as leaf records, but a more accurate estimate of the periodicity in flowering may be obtained from palms which are con-

SCIENTIFIC NAME: *Mascarena verschaffeltii (Wendl.) Bailey*

DATE OF PLANTING: *1942*

AGE: *from seed : 28 yrs.*

LOCALITY: *F. T. G. Coral Gables, Florida*

SOIL TYPE: *Limestone rock ; well-drained*

TOTAL HEIGHT: *16'*

LENGTH OF VISIBLE TRUNK: *11'*

DIAMETER AT BREAST HEIGHT /D.B.H./: *11"*

FLOWERING CONDITION ACHIEVED: *Yes*

38. Data card.

DATE OF FIRST MARKING: *11 · XII · 62*

/YOUNGEST FULLY EXPANDED LEAF
OR OLDEST MATURE LEAF/

11 · III · 63

MONTHS	3	6	9	12	15	18	21
LEAVES EXPANDED OR LEAF SCARS EXPOSED	/						
OPEN FLOWERS	+						
RIPE FRUITS	O						

39. Data card, reverse side.

stantly observed by inserting the date of flowering and fruiting in the space available.

It must be emphasized, however, that the method of keeping notes is not important. It is the records themselves and their accuracy which are significant.

Period of Observation

Records should be kept for at least a year. This might be timed to correspond to the proposed International Palm Year. But the longer records are kept, the more useful they become, since a much better average estimate becomes possible. At the end of a year's observation and possibly at yearly intervals thereafter a copy of the records should be sent to me on 3 x 5 inch filing cards. Members of the Society will be kept in touch with the progress of this scheme through the pages of PRINCIPES.

Selection of Palms for Study

Unlimited observations are required on all species of palms. The only restriction is that palms under study should have occupied their existing site for at least a year. Palms take a considerable time to recover after transplanting. For similar obvious reasons palms under study should not be moved during the course of the observations. It is, however, quite legitimate to keep records of growth rates in small palms grown in pots, provided these are well established, are not re-potted during the period of study and do not have the environment of the pot drastically changed.

An observer need not feel that records can only be kept by people with large and varied collections. Records are needed of the commonest, as well as the rarest palms. Records are needed of many different individuals of a single species; if these individuals are growing close together we can learn something about individual variation in growth rate, if the palms occupy different localities we can learn something about the effect of soil and climate on growth rates. Thus an individual with only one species available for study might keep just as many records as an observer with dozens of different species available.

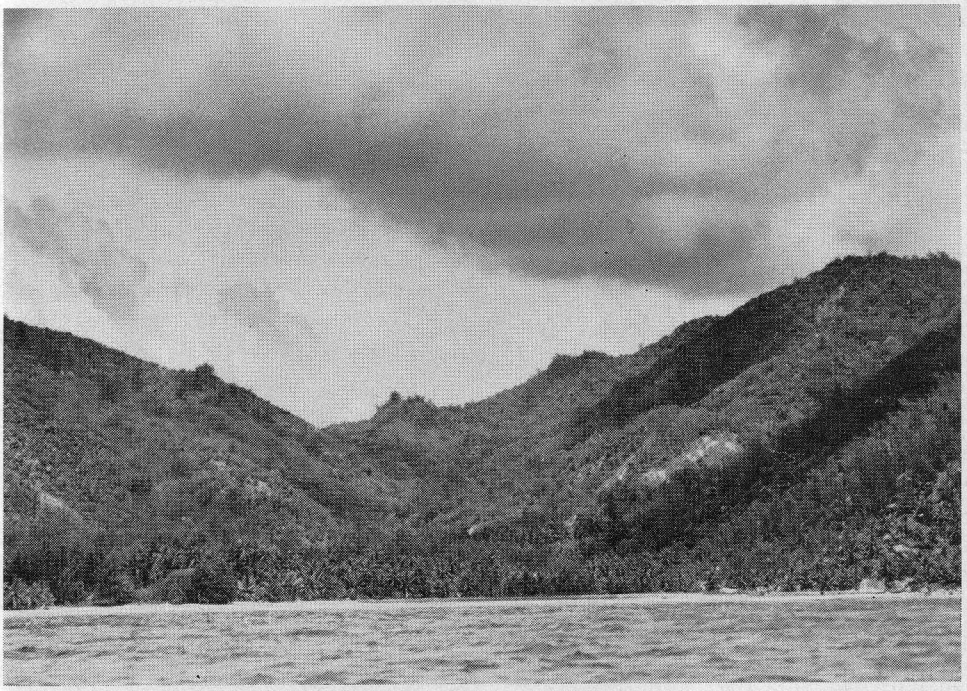
Also observations are needed on palms, whether of the same species or not, which are of different ages. Obviously most records are going to come from small palms since these can be tagged at ground level with little effort. But a conscious effort must be made to tag older and taller palms. Information is needed to decide if old palms grow as fast as young ones. As a suggestion a tall palm growing near a building may be easily observed from an upper story. Otherwise a ladder can be used.

One final note should be added. This is not a competition and no prize goes to the observer who sends in the most records or measures the fastest rate of growth. The only reward is the satisfaction of doing something fundamentally useful and perhaps, by watching closely the growth of a palm, of learning to understand it a little more.

A Visit to the Seychelles

COUNT F. M. KNUTH
Knuthenborg, Bandholm, Denmark

Among the many travellers who visit India are undoubtedly a considerable number of nature lovers, many of whom are not aware that the remote Seychelles islands are easily reached from Bombay and that a round trip, with a week's sojourn in the islands, can be made in three weeks by the steamers of the Brit-



40. Praslin Island and Vallée de Mai from the sea.

ish India Line which ply between Bombay and Mombasa-South Africa. These steamers are large and comfortable and offer the usual entertainments and good food, of the English type but prepared by Indian chefs. The B. I. Line quotes special rates for such round trips.

A trip to the Seychelles is, from all points of view, rewarding. After a normally very pleasant five days' journey under tropical skies you wake up one early morning and feel that the ship is no longer moving; and looking out of your port-hole you discover it is anchored in a wide, calm bay studded with green islands. These are granitic, steep, even mountainous. Barges and launches are on their way out to the ship from the port of Victoria, a mile and a half distant, still partly shrouded in morning mists. You hurry on deck. On one side you see, close to the ship, the towering rocks and coconut plantations of two minor islands; on the three other sides, the main island of Mahé with the capital town, its houses partly hidden under an open canopy of palms and other trees. Behind the town the impressive Morne Séchellois raises its green-clad head. A hurried breakfast; entry formalities completed in no time and crowned by

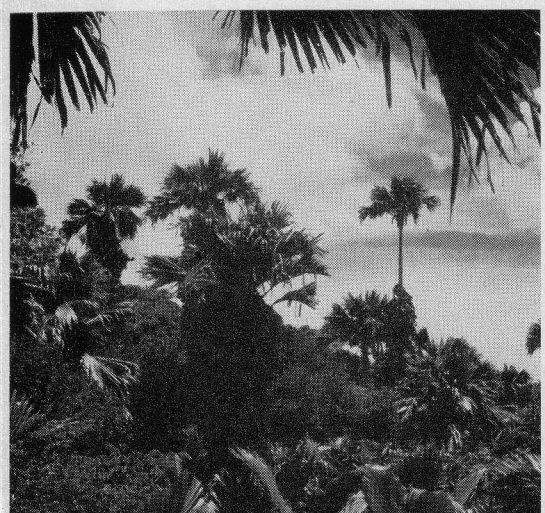
41. Entrance to Nature Reserve at Vallée de Mai. The palm is *Lodoicea*.

your being welcomed by a charming representative of the government tourist office. A launch takes you ashore, a taxi brings you to your hotel, and you are "a thousand miles from anywhere."

A plant lover and palm enthusiast will want to see the remaining stands of the coco de mer, *Lodoicea maldivica*, more than anything else. I therefore headed for the Department of Agriculture, the buildings of which are situated in the Botanic Garden of Victoria. I had the good fortune to meet Mr. Guy Lionnet, the Director of Agriculture, and he most helpfully gave me all information needed in order to visit the habitat of the coco de mer and those of some other endemic plants. In the garden proper I noted a magnificent avenue of fruiting or flowering *Lodoicea* and in a shed I saw an impressive quantity of "heavy" (i.e., fresh) seednuts intended for shipment to botanical gardens in other parts of the world. I arranged to have some cases of these shipped to institutions in the South Pacific area where there was an interest in introducing (or re-introducing) this unique plant into their islands.

Next day I embarked in the "Lady Esme," a ferry-boat which in three hours sailed me across the open ocean to Praslin island where primary — although not undisturbed — stands of the coco de mer exist. My goal was the Vallée de Mai which is now owned by the government and has been declared a nature reserve.

42. Tall *Lodoicea maldivica* trees silhouetted against the sky, Vallée de Mai.



A driver took me in his VW van along a good, tar-sealed road which leads from the landing pier, through a small village, over steep grades up into the Vallée de Mai, further on across the main ridge of the island and then down again until it reaches the eastern shore. Many houses along the road are thatched with fronds of *Phoenicophorium Borsigianum* (*Stevensonia grandifolia*) and some houses even have walls covered with these strong, durable one-piece fans arranged in symmetrical patterns. On the outskirts of the village I passed a fine vanilla plantation which was at the same time a timber grove. The supports for the vanilla vines were not of the usual worthless species like bauhinia which have little or no timber value but tall, straight casuarinas which would in a few years' time yield a considerable quantity of good timber. Used to seeing casuarina as a greedy shelter-row tree under which scarcely a blade of grass will grow, I stopped and inspected the planting. I found that a heavy mulch of coconut husks had been placed around each tree, and that the vanillas were rooted in this thick, moist layer and not in the underlying sandy soil in which they would have met fierce competition from the densely matted casuarina roots.

Proceeding further upwards I reached a moist ravine in which a small river cascaded over rocks and boulders. Close to the water stood a dense thicket of stilted pandani interspersed with specimens of *Verschaffeltia* and *Phoenicophorium*. On the forest floor the shade was dense but the palm crowns seemed to receive a fair amount of sunlight. I

had now reached an altitude of about 500 feet; the air was fresh. The steep sides of the valley carried close stands of coco de mer trees. The road continued

43. Young trees of *Lodoicea.*

steeply upwards and soon I reached a point where a footpath branched off, leading into the depths of the *Lodoicea* forest.

44. *Lodoicea* in fruit.

I followed this path which winds its way over rocks and knolls, past bends and into hollows. Venerable giants stood in clumps and groups and raised their

45. *Verschaffeltia splendida* (rear) and *Deckenia nobilis* (foreground), Vallée de Mai.

heads into the azure sky, the breeze producing a loud, rattling noise in their fronds. Young specimens in all stages of development were present everywhere, in places forming almost impenetrable thickets of huge, still stemless plants. In such places, mainly in the lower parts of the forest, the ground was covered with thick layers of fallen fronds which made a crackling sound under the feet. It was like walking on roofing iron shattered and crumpled by a hurricane.

The Vallée de Mai forest is no longer a pure *Lodoicea* forest. Scattered trees of *Verschaffeltia splendida* occur, and here and there are seen groups of *Deckenia nobilis*. Other kinds of trees, such as gums (*Eucalyptus* sp.), country almonds (*Terminalia Catappa*) and cashews (*Anacardium occidentale*) have also intruded into these haunts where, maybe for millions of years, one of Nature's great princes has ruled undisputed.

It is an experience not easily forgotten to visit this remote and secluded valley and to wander as in an immense temple where no extraneous sight or sound disturbs the mind. Certainly, it is to be hoped that the Government of the Seychelles may have success in its endeavours to preserve and maintain this unique monument, to defend it against the actions of man and beast, protect it against the ever-present danger of ravaging fire and heal the wounds that have been inflicted during the brief period since the islands were colonized.

I found my way back after an all too short stay under the giants, passed the ravine with the murmuring brook, the well-tended vanilla vines under their canopy of ironwoods, and returned to the village just in time to swallow a hurried lunch at the rest-house and catch the ferry-boat returning to Mahé island. At the pier a crowd of local passengers was waiting in the shade of a *Phoenicophorium*-thatched roof erected on white-washed pillars; and then the ferry arrived and picked us up.

For the following day Mr. Lionnet had arranged a visit to the reforestation areas in the hills above Victoria. A Land-Rover took me along a steeply ascending road with hairpin bends up to Sanssouci where a forest nursery is operated. There I met the district forester who first showed me the various seedlings grown in his beautifully kept nursery beds and then accompanied me on a walk all the way up to the highest point of the road where it starts its winding descent through the depleted forests of the western side of the island. Above us rose the towering massif of Morne Séchellois, the highest mountain of Mahé and of the group.

We passed through fine, 10-to12-year-old stands of timber trees, several of which I had not seen used in silviculture elsewhere; *Sandoricum indicum*, *Calophyllum inophyllum*, *Terminalia Catappa*, *Pterocarpus indicus* and the Honduras mahogany (*Swietenia macrophylla*) were among them. This upland country seems to hold great promise for timber growing. Of palms I noticed but few until we reached the watershed near which I noted some magnificent, many-stemmed thickets of *Raphia farinifera* which has become naturalized. The view was breathtaking: hills and mountain spurs; the capital of Victoria; the wide, calm bay with its cluster of hilly islands; and the fertile coastal lands with their unbroken belt of coconut plantations.

We made our way back to the forest station near which I saw numerous plants of *Raphia*, both seedlings and mature specimens. This species is reported to have longer leaves than any other palm in the world, up to 60 feet

long, but I did not see any approaching this fantastic length.

In a water-drenched bog at the edge of a mountain stream I saw several

46. *Raphia farinifera*, Sanssouci, Mahé Island.

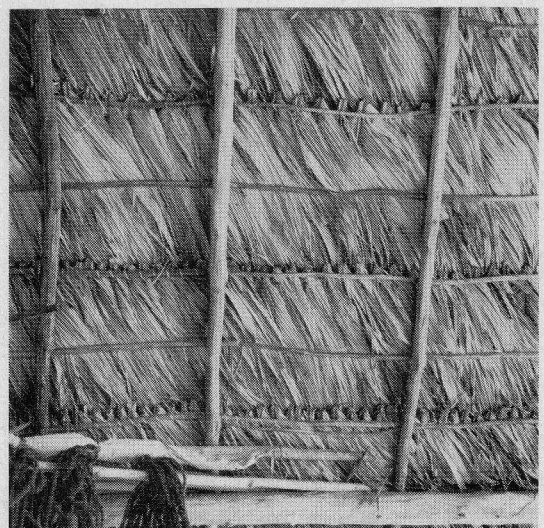
47. *Nephrosperma Vanhoutteanum* in water-drenched bog at edge of mountain stream near Sanssouci forestry station, Mahé Island.

plants of the small, one-stemmed palm *Nephrosperma Vanhoutteanum*, happy and healthy with wet feet and in partial shade from overhanging tall trees.

The following days I made trips along the coasts. The scenery is magnificent everywhere: green, coconut-clad hills or, here and there, expanses of level land, also under coconuts. The northeastern coast is rocky in most places, strewn with gigantic boulders, but small sand beaches occur in all sheltered places. Cinnamon (*Cinnamomum zeylanicum*), which was introduced 200 years ago, occurs almost everywhere as a dense coppice under the coconut trees; small cinnamon distilleries take care of a major part of the crop.

On the west coast are some long, beautiful beaches and some attractive hotels have been built nearby. The land is under coconuts also there.

48. Thatch of *Phoenicophorium*.



The Seychelles race of coconut tree is small-fruited but high-yielding. The most serious pest of the area is the *Melittoma* stem-borer, a pest occurring only in the Mascarene islands. Before the Department of Agriculture brought it under control it caused the death of thousands of trees. The cure is radical: the stems are hollowed out with an adze, sometimes to a height of 6-8 feet, the grubs and the surrounding dead wood are chopped out, and the large wound is then painted with asphalt. Sometimes the treatment has to be repeated the following year.

The largest coconut plantation of the islands is owned by Mr. Douglas Bailey, O.B.E., J.P., a keen writer on botanical and zoological subjects. His "List of the flowering plants and ferns of Seychelles" is familiar to all students of the islands' flora. I had the privilege of meeting Mr. and Mrs. Bailey in their home, a charming old-style tropical house with spacious, airy verandahs and beautifully polished hardwood floors of a timber reminiscent of the famous tamanu (*Calophyllum vitiense*) so highly esteemed in the South Pacific islands. Mr. Bailey's huge copra kilns, which are of the type with a fixed wire-screen floor above a large oven, were a model of tidiness and efficient operation. In co-operation with the Department of Agriculture Mr. Bailey was running extensive mulching trials with spent cinnamon leaves under coconuts on the light, level soils near the coast.

The Seychelles were colonized by the French but came under British rule during the Napoleonic wars. A large section of the population is of African descent and a type of creole French is a language in common use. A visitor will

soon find himself at home in an island atmosphere of peace and tranquility. He will have no difficulty in finding a nice, quiet hotel in pleasant surroundings but

49. *Phoenicophorium Borsigianum* in deep shade of *Pandanus* thicket near river, about 500 ft. altitude, Praslin Island.

he must not expect to be served French or French-creole food, nor should he expect to meet any expressions of an indigenous culture, be it dancing, music or poetry. What culture originally may have existed appears to have been wiped out or, some say, went underground during the hard times of early colonial settlement. In this respect the Seychelles stand in a striking contrast to the South Pacific islands and even to the West Indies. Still, the visitor will find much worth coming for — glorious scenery, a unique flora, a near-ideal climate but one in which mosquitoes will not thrive, good roads, good hotels and, first and last, nice, hospitable people.

History of the Coconut Palm in America

O. F. Cook

Cook's views of the origin and history of the coconut palm, as published in *Contributions from the United States National Herbarium* 14: 271-342, 1910, are too lengthy to reprint in their entirety. The summary (pp. 338-342) is reprinted here in conjunction with the reprinting of Beccari's opposing views. Both the above paper and an earlier one "The Origin and Distribution of the Cocoa Palm" in *Contributions from the United States National Herbarium* 7: 257-293, 1901, should be read by those interested in the matter.

SUMMARY OF RESULTS

The history of the coconut palm has relation to several different kinds of scientific questions, so that the facts require to be summarized from several different standpoints.

Botanical Conclusions

All the palms that are related to the coconut, comprising about 20 genera and 200 species, are natives of America, with the possible exception of a single species, the West African oil palm. All the species of the genus *Cocos* and of the closely allied genera are natives of South America. The species of *Cocos* that are most related to the coconut are natives of the interior valleys and plateaus of the Andes, where the coconut also thrives, remote from the sea.

Comparison of the structure of the fruit and the method of germination of the coconut with those of the related palms indicates a high degree of specialization, but not for purposes of maritime distribution. The unusually large, heavy seed and the thick, fibrous husk are to be considered as adaptations for protecting the embryo, assisting in germination, and establishing the young plants in the dry climates of interior localities, the only conditions where this palm could be expected to maintain its existence in a wild state.

The habits of the coconut palm afford no indication that its original habitat was on the seacoast, and none of its closer relatives have maritime habits or maritime distribution. The coconut palm does not appear to be able to maintain itself under littoral conditions without the assistance of man. Though carried by man to all of the warmer parts of the earth, it has not been able to establish itself as a wild plant on any tropical coast, but is always crowded out by other vegetation after human care is withdrawn.

Wafer's circumstantial account of the existence of large numbers of coconut palms on the Cocos Islands, 300 miles west of Panama, in 1685, taken together with their almost complete disappearance at the present day, affords a striking illustration of the dependence of the coconut upon human assistance not only for its distribution, but for its continued existence on oceanic islands.

The dissemination of the coco palm along the tropical coasts is to be ascribed

to the agency of primitive man, as with the sweet potato, banana, and other domesticated plants which were widely distributed in prehistoric times. The theory that it has been disseminated by ocean currents is gratuitous, unproved, and improbable.

The development of distinct varieties of the coconut has not been confined to the Polynesian and Malayan islands. Distinct varieties are also to be found in isolated localities in America, such as the Soconusco region of Mexico and the island of Porto Rico.

The existence of many and diverse varieties in the Malay region does not indicate that the species is native there, but the opposite, since the proximity of the wild stock of a species is likely to hinder the appearance and preservation of mutations among its cultivated representatives. The relative uniformity of the coconuts of America is in accord with the probability of an origin in this hemisphere. The discovery of distinct varities in isolated localities in America accords with the probability that the Malayan varieties have arisen, like other cultivated varieties, through segregation and mutation rather than by gradual evolution and natural selection.

Historical Conclusions

At the time of the discovery of America the coconut was not confined to the Pacific side of the Isthmus of Panama, as De Candolle believed, but was already widely distributed along the Atlantic side of the American tropics. Early records show its presence in Cuba, Porto Rico, Brazil, and Colombia at dates so early as to preclude the idea of introduction by the Spaniards.

The statement of Pickering, frequently quoted in works of reference, to the effect that coconuts were reported by Columbus on the coast of Central America during his fourth voyage, proves to be erroneous. On the other hand, there appears to be a definite reference to the coconut in Cuba in the journal of the first voyage of Columbus.

De Candolle's inference from Acosta's report of coconuts in Porto Rico at the end of the sixteenth century, that they had recently been introduced by the Spaniards, proves to have no warrant in history and is directly opposed by the more extended reference to the coconut in Porto Rico by the Duke of Cumberland's chaplain, who visited the island only a few years after Acosta.

De Candolle's use of the testimony of Piso and Marcgrave to support the idea of the introduction of the coconut into Brazil by Europeans is also unwarranted, since those writers only indicated that the plant was cultivated. An earlier and more explicit record, unknown to De Candolle, gives an account of the coconut as one of the native products of Brazil.

The journal of Cieza de Leon, who accompanied the first Spanish expedition to the interior of Colombia, indicates the presence of the coconut palm in localities where it still continues to exist, as shown by the accounts of Velasco, Humboldt, and more recent travelers, down to the present decade.

Ethnological Conclusions

The American origin of the coconut palm and the strict limitation of its status in maritime tropics to that of a cultivated plant are facts of ethnological significance. The wide distribution of the coconut in prehistoric times is evidence of the antiquity of agriculture in America and of very early communication across the Pacific.

The American origin of the coconut palm, along with its inability to maintain itself on tropical seacoasts without human assistance, compels us to believe that its trans-Pacific distribution was the

work of primitive man. The dependence of the Pacific islanders upon the coconut may be taken to show that these islands could not have been occupied without the previous domestication and dissemination of the coconut.

In view of the fact that several other palms of unquestioned American origin have been domesticated by aborigines of the American tropics, no ethnological objection can be raised to the idea that the coconut palm was originally domesticated in ancient America.

The name "coco" does not appear to have been applied to the "Indian nut" till after the discovery of America and is to be considered as a word derived from the natives of the West Indies. Other natives names for the coconut are found among primitive tribes of Costa Rica, as well as in Brazil.

The presence of large numbers of coconuts on Cocos Island in the time of Wafer (1685) and their subsequent disappearance should be considered as evidence that the island was formerly inhabited, or at least regularly visited, by the maritime natives of the adjacent mainland.

The fact that the coconut is largely restricted to islands and tropical countries of low elevation explains its importance among the pre-eminently maritime people of the Old World tropics and its relatively slight importance among the non-maritime natives of the lowland tropics of America.

The evidence of the prehistoric dissemination of the coconut and other American cultivated plants across the Pacific Ocean is such as to warrant a careful consideration of other indications that agricultural civilization developed originally in America and was distributed to the shores of the Pacific and Indian Oceans by a primitive people with agricultural and maritime habits, like those of the Polynesians and Malays.

The existence of a distinct tribe of frizzle-haired people near the Isthmus of Panama at the time of the discovery does not rest alone on Peter Martyr's casual mention of the finding of negroes, but is supported by Oviedo's contemporary history written directly from the testimony of Balboa and other members of his expedition, just after their return to Darien. The facts are not to be explained reasonably by assuming a chance arrival of African negroes, but indicate that prehistoric communication across the Pacific continued after the frizzle-haired Melanesian race had spread eastward in the Pacific.

Such communication would account for the existence of the banana plant in America previous to the arrival of the Spaniards, as well as for the Old World distribution of the coconut palm and other cultivated plants of American origin. The banana plant is as evidently a native of the eastern continent as the coconut palm of the western. Evidence of these facts appears very definite and concrete from the biological standpoint, and is worthy of careful consideration by ethnologists.

Agricultural Conclusions

The coconut is confined to seacoasts only in the humid lowlands of the Tropics; in dry regions it is not restricted to coasts, but thrives in many districts remote from the sea. The fact that it received scientific study only as a maritime plant should not longer obscure the fact that it is also adapted to interior localities with saline soils. The cultural problems of the coconut palm should be investigated quite apart from the idea of maritime habits and distribution.

The possibility of raising coconuts in frost-free localities outside the Tropics is not to be tested along the seacoast, but

in interior districts where larger amounts of sunlight and heat are available, as in the valleys of southern California and Arizona. The coconut, like many other palms, is not tolerant of shade nor of long continued cool and cloudy weather. Other species of *Cocos* that are less exacting in their requirements of sunlight and heat have been found to do well along the California coast.

The possibility of introducing coconut palms into southern California is not disproved by the absence of these palms from Egypt and Palestine. Though the climatic conditions are probably favorable, it does not appear that any adequate effort has been made to introduce the palms in those countries.

The ability of the coconut to thrive on seacoasts shows that its requirements of heat are not as great as those of the date palm. Though probably less hardy than the date palm, it is not impossible that the coconut may be able to exist in frost-free localities that have not enough heat for the ripening of dates.

The possibility of introducing the coconut palm into southern California and Arizona can not be fairly tested by the planting of the maritime varieties. The chances of success will be very much greater with the varieties that are adapted to the dry interior localities of the temperate plateaus of the Andes.

The Origin and Dispersal of Cocos nucifera

O. Beccari

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Having had the opportunity of meeting Mr. J. F. Rock shortly after his trip to the Palmyra Islands I became much interested in his account of the exceptional conditions which he found in the flora of this small and isolated group. This flora proves, at least as far as the phanerogams are concerned, to be composed of an extraordinarily small number of species, belonging to the common strand flora of the Malay Archipelago and Polynesia, and of the coconut palm, which composes nearly the whole of the forests that cover these islands.

The Palmyra Islands belong to the category of those uninhabited coral islands, covered with dense groves of coconut palms, and of which Simmonds writes, as reported by O. F. Cook,(1) "the ungathered nuts which have fallen year after year, lie upon the ground in incredible quantities."

The special circumstances in which the Palmyra Islands are placed; their coral origin; their isolation, consequent to the great distance from any other land; the complete absence of indigenous inhabitants; the want of drinking water; the absence of any traces of economic plants that might suggest that they had ever been inhabited; and the certainty that they are but seldom visited either by fishermen or by any person who had tried to turn their wealth (which consists of the coconut solely) into a source of profit — all these give me the occasion, in addition to describing the peculiar characteristics of the coconut produced in these islands,(2) to offer certain considerations of an evolutionary and geographic nature, opposed to those which Mr. O. F. Cook has advanced with much competence and erudition in his two memoirs on the

(1) History of the coconut palm in America, *Contr. U. S. Nat. Herb.* 14 (1910) 298.

(2) *Cocos nucifera* Linn. forma *palmyrensis* Becc. in Rock, J. F., Palmyra Island with a description of its flora, *College of Hawaii Bull.* 4 (1916) 1-53, *t. 1-20.*

coconut palm.([3]) Cook, in effect, sustains three principal theses, with which I entirely disagree. They are:

1. That *Cocos nucifera* must have assumed its actual specific characters upon the American continent, where it was found by Polynesian navigators, who later diffused it among their own islands, from whence it passed at a still later date into the Malay Archipelago and to the continent of Asia.

2. That *Cocos nucifera* in Asia, Malaya, and Polynesia, as in all other places where it is now found, can in no wise dispense with man's assistance and protection, without which it is incapable of maintaining its existence on the sea coasts.

3. That the ocean currents *cannot* have been efficacious means of its diffusion or be responsible for its wide distribution.

I have been the more induced to write these criticisms of Mr. Cook's assertions because this opinion of the American origin of the coconut palm appears to have found favor with several scientific authorities, among them Hugo de Vries([4]) and Geoffrey Smith.([5]).

Is the Coconut Palm of South American Origin?

According to the thesis so ably and fully sustained by Cook, *Cocos nucifera* cannot be of Asiatic, Polynesian, or Malayan origin, but must be "a native of South America and carried westward across the Pacific in prehistoric times;" and its "original home must be sought in some sheltered valley of the Equatorial Andes."

([3]) The origin and distribution of the cocoa palm, *Contr. U. S. Nat. Herb.* 7 (1901) 257-293; and History of the coconut palm in America, *ibid.* 14 (1910) 271-342. The first of these memoirs will be denoted by "I" in this article; the second, by "II."

([4]) Species and Varieties, etc., ed. 2, p. 82.

([5]) The Cambridge Natural History 4 (1909) Crustacea 173.

The old argument — and it was a very good one for holding *Cocos nucifera* to be of American origin — namely, that all the other members of the *Cocoineae* (except *Elaeis guineensis*) are American,([6]) has no longer any great weight, in view of the exceptions that recent botanical discoveries have made known.

In fact, the existence of a distinct species of *Elaeis* in Madagascar, different from *E. guineensis*, *E. madagascariensis* Beccari,([7]) and the discovery of another true *Cocoinea*, *Jubaeopsis caffra* Beccari,([8]) in South Africa, must weaken the belief in a necessarily American origin of all the *Cocoineae*.

Indeed, *Jubaeopsis caffra* turns out to have many more affinities with *Cocos nucifera* than has any other palm whatever among those hitherto referred by authors to the genus *Cocos*.([9])

([6]) The presence in Madagascar of a species of *Elaeis* distinct from *E. guineensis*, almost induces me to suspect that the genus *Elaeis* should be regarded as being really African, and that instead of a representative having been carried from America to Africa, precisely the contrary occurred, and that the American *Elaeis melanococca* must be considered to be of African origin.

([7]) Beccari, Palma del Madagascar 55, *f. 46;* Contributo alla conoscenza della Palma a olio (1914) 72, *t. 18.*

([8]) Webbia 4: 169.

([9]) After further careful study, I think it better to regard as distinct genera the subgenera *Arecastrum*, *Butia*, and *Glaziova*, proposed by me in Malpighia 5 (1888) 343. (Le Palme incluse nel genere *Cocos*). The genus *Arecastrum* is composed only of C. *Romanzoffiana* Cham., with its numerous varieties or subspecies and of the hardly specifically distinct *C. botryophora* Mart. To the genus *Butia* belong *C. capitata* Mart., and its numerous forms known by the names of *C. odorata* Barb. Rodr., *C. pulposa* Barb.-Rodr., *C. lejospatha* Barb.-Rodr., and several others cultivated in our gardens under the names of *C. australis*, *C. campestris*, etc. The following are species of *Butia* also; *C. Yatay* Mart., C. *paraguaensis* Barb.-Rodr. (probably only a variety of *C. Yatay*), *C. eriospatha* Mart. ex Drude, and probably *C. stolonifera* Barb.-Rodr. Species of *Glaziova* are: *C. Weddelliana* Wendl., *C. coronata* Mart., C. *comosa* Mart., *C. petraea* Mart., *C. campestris* Mart., *C. flexuosa* Mart., and

I have already shown elsewhere that *Cocos nucifera* is a monotypic palm, with but few affinities with the other palms included in the genus *Cocos*,([10]) whereas it has much in common with *Jubaeopsis*; namely, the general conformation of the fruit; the ample central cavity of the seed; and the male flowers with sepals entirely free and imbricated. This affinity to *Jubaeopsis* had led me to hazard a doubt as to whether *Cocos nucifera* may have originated, not in Polynesia or in some lands which have now disappeared from that part of the Pacific as I formerly supposed,([11]) but rather in the islands lying in the eastern Indian Ocean or in some other lands or islands, existing in former times between Africa and India.([12]) According to this hypothesis, Ceylon and the Keeling Islands must lie almost in the region where *Cocos nucifera* assumed its present specific characters. The species *Eugeissonia*, belonging to a genus of palms peculiar to the Malay region, which until now have been referred to the *Lepidocaryeae*, I have shown to have more affinity with the *Cocoineae* than with the *Lepidocaryeae*.([13]) In the face of these facts the American origin of all the *Cocoineae* can no longer be considered as absolutely proved.

The Association of Birgus Latro with the Coconut Palm

Birgus latro, the huge robber crab which is widely disseminated throughout Asiatic archipelagoes and Polynesia, is found also in the Palmyra Islands, and from Mr. Rock's account it abounds in that group along with other crustaceans. I have already made use of the association of *Birgus* with the coconut palm([14]) as an argument against the suggested American origin of *Cocos nucifera;* for it seems to me to be inadmissible that *Birgus* could have been specifically evolved independently of the coconut. Without coconuts it would have nothing to live upon; whereas, if this association did not exist, the peculiar and special formation of this crab's prehensile organs — thanks to which it is able to grasp and break open the coconuts, which are its only means of subsistence, to say nothing of its climbing the trees which bear them — would surely not have come into existence. In any case, it seems to me that this association can hardly have originated in those eastern valleys of Peru wherein Cook insists that *Cocos nucifera* had its origin. It is also a noteworthy fact that *Birgus* is found in association with the coconut palm even in places far distant from each other and to which this palm might be held to have spread in a natural way, such as the Keeling Islands in the Indian Ocean and the Palmyra group in the Pacific.

I do not know if *Birgus* has been found in the Cocos Islands, in the Pacific, where however I should not be surprised if it existed; because, although the adult *Birgus* is a creature adapted to a terrestrial life, in the larval, or "zoaea," states it has a pelagic existence and, therefore, can be carried enormous distances. Nevertheless, *Birgus* seems to be absolutely unknown on the American shores of the Pacific. This gives me the opportunity to suggest the hypothesis that the long-enduring biological connection between *Birgus* and the coconut palm, which in the course of time has had the power of modifying certain or-

numerous other species described by Drude in the Flora Brasiliensis and by Barbosa-Rodriguez in his Sertum palmarum. On the whole the species of *Glaziova* amount to more than forty. *Cocos schizophylla* Mart. is *Aricuriroba Capanemae* Barb.-Rodr. (*Aricuri schizophylla* Becc.).

([10]) Ann. Bot. Gard. Buitenz. Suppl. 3 (1910) 795.

([11]) Op. cit. 802.

([12]) Webbia, l. c.

([13]) Webbia 4: 190.

([14]) Ann. Bot. Gard. Buitenz. Suppl. 3 (1910) 804.

gans in *Birgus*, likewise has had the same influence in causing the coconut palm to assume some peculiar features. I allude to the extraordinary thickening of the pericarp, which from a teleological point of view has been attributed either to the advantage it gives to the fruit when floating, by which its dispersal is favored, or to the importance of deadening the shock when it falls from the tree. This second opinion is also shared by Hugo de Vries in the work above cited. My idea is that this great development of the pericarp may be attributed to the effect of the stimulus given by the crabs during the plasmatic period to the pericarp of the young fruits, by their efforts to reach the seed, which may have caused an hypertrophy of the tissues of the pericarp itself, leading to the production of a fibrous, corklike tissue of a protective nature, such as is the bark of a tree. In consequence and by the light nature of this tissue, the fruit is made capable of floating independently of any final cause; thus some among the many fruits produced became very light, and for this cause alone their dispersal was favored in preference to that of the heavy fruits. All this, however, rests on the supposition that *Birgus* really is in the habit of climbing the coconut palm and that it does so to get at the immature fruits. In this connection I may observe that when in the Moluccas I often found imperfectly matured coconuts on the ground, which were more or less gnawed and entirely emptied of their kernels. This the natives assured me was the work of *Birgus latro*.

On the other hand Guppy([15]) writes that he never saw *Birgus* unhusk the coconuts given to them for food when kept in captivity, but that to keep them alive it was necessary that the nuts should be opened for them. Hence it is not perfectly certain that *Birgus* succeeds in unhusking the coconuts when these are quite ripe and have fallen in the natural course to the ground.([16])

It seems to me that if the nut were not free from the husk, at least partly, it would be very difficult for *Birgus* to get at the kernel of a ripe coconut in a dry state through the dense stratum of the fibrous cork-like tissue of the mesocarp; whereas, it could easily do so in a young immature fruit. This would explain why *Birgus* is forced to climb the trees to provide itself with fresh nuts; whereas, it might make use of the fallen fruits, if it could open them.

However, it is easy to suppose that *Birgus* may make use even of the fallen fruits by attacking those that are beginning to germinate; for in such cases it is possible that it might succeed in reaching the albumen by gnawing at the young sprout with its mandibles.

Did the Coconut Palm Exist in America Before the Discovery of that Continent by Christopher Columbus?

Admitting that the coconut palm did exist in America on the Pacific coast before the discovery of the continent by Europeans, the data, on which Cook formed his opinion that from there it was disseminated on the Atlantic side, are so few and uncertain, that they offer little that can convince one of the correctness of his thesis. On the other hand, I cannot but wonder why the first sailors

([15]) Guppy, H. B., The Solomon Islands, 320.

([16]) The botanist who accompanied Judge Cooper on his first expedition to Palmyra Island would remark here that he has personally observed *Birgus latro* unhusking coconuts. He more than once watched it in its laborious work, tearing fiber after fiber from the nuts found on the ground. He has also found the nests of *Birgus* filled several inches thick and covering many square feet of ground with the fibers of the coconut, each fiber single. He has not observed *Birgus* climbing the trees, but on board ship a *Birgus* climbed to the top of a 100-foot mast. — J. F. Rock.

who reached that continent have not even mentioned the coconut palm, if for no other reason than because of the refreshing milk its fruit contains; whereas, there is not a sailor in the East who does not speak of the natives bringing coconuts to strangers to quench their thirst. Amerigo Vespucci, in his voyages — and he was the first who sailed along the whole length of the tropical east coast of America to the Gulf of Mexico and the Antilles — does not once tell us that the natives offered him anything of the kind. This appears very strange, since in Asia and in the Malayan islands coconuts are almost the first things offered by the natives to all new comers. I have no difficulty in admitting that Polynesians, Malayans, or Papuans may have reached and established themselves on the Pacific shore of tropical America,([17]) and that they may have carried thither the coconut palm together with the banana; but I positively cannot admit that they found the coconut palm on the American shores of the Pacific, carried it back with them, and disseminated it throughout Polynesia and tropical Asia.

The difficulty brought forward by Cook, that the coconut palm could not have been introduced into America by the Spaniards or by the Portuguese, because the fruits could not have preserved their germinative faculties during so long a voyage, has no force; because, Cook's assertion to the contrary, coconuts can withstand several months' dryness, especially if kept under the influence of sea air; moreover, they can germinate while hanging in the rigging of a ship. It is exceedingly common in the Malayan islands to see a bundle of coconuts sprouting while hanging to the posts of a hut.

With respect to the origin of *Cocos nucifera* and its supposed native land among the salt-bearing regions of eastern Peru, Cook concludes by saying (II, p. 307):

"It would be reasonable to turn to these saline districts of South America if any attempts were to be made to definitely ascertain the original home of the coconut by finding it in a truly wild state." Fortunately the author hastens to add: "Such a discovery is hardly to be expected, because of the probability that localities suited to the spontaneous growth of coconuts would have attracted human inhabitants, even in very early times."

But in that case will Mr. Cook tell us why he holds that in such localities *Cocos nucifera* could have constituted itself as a specific entity, have grown, and reproduced itself, without the assistance of man, but yet not have done so on the oceanic coral islands?

And again:

"We may hope, however, to find a

([17]) The belief, widely accredited, that natives of Asiatic, Polynesian, or Papuan origin exist on the western coasts of Central America would appear to be confirmed also by what Amerigo Vespucci writes in the account of his first voyage [Libro de viaggi di Amerigo Vespucci, di Stanislao Canovai: Firenze, Tipografia Tofani (1832)]. He relates that while sailing (as it would seem) along the coasts of the Caribbean Sea, in the neighborhood of the Isthmus of Panama, he landed on an island in that sea about 15 leagues from the mainland, in which he found the most brutish and hideous people he had ever seen; he says that these savages had their mouths so full of an herb which they continually chewed that they could hardly speak. Each wore at his neck two small dry gourds, one holding the herb they were chewing, the other containing a white powder, which looked like powdered gypsum; into this one they dipped from time to time a little stick of the shape of a spindle, previously moistened in their mouths, and therewith flavored the herb they chewed with the aforesaid powder. It seems indubitable to me that such a custom corresponds to that which generally prevails among the Malays and other Asiatic populations at this day, of chewing the leaf of the betel and other things together with powdered lime, for the last must have been the white powder of which Vespucci speaks.

series of local varieties or subspecies of the coconut palm in these interior localities, varieties that will be more hardy and vigorous than the maritime forms of the palm cultivated in the humid parts of the Tropics, and more likely to thrive under semi-tropical conditions."

Such a search can very well be carried out by some enterprising botanist; but, as a matter of fact, no one has met with such forms or varieties of *Cocos nucifera* in the regions mentioned. I do not claim, however, that such an event is absolutely improbable or that varieties and species of *Cocos* as yet unknown to botanists, possessing more affinity with *Cocos nucifera* than have any of the other *Cocoineae* known hitherto, may not be found in such localities; but such a find would be a less extraordinary thing than that the big fruits of the coconut palm should have crossed the Andes and thence have been dispersed among the islands of the Pacific.

Dissemination of the Coconut by Maritime Agency

Cook writes (I, p. 276) that the ocean currents are an effective agency for the dissemination of the coconut and that "the theory of the transfer of fruits by ocean currents has received much attention and far greater credence than the facts seem to warrant." "The poetic theory of the cocoanut palm dropping its fruit into the sea to float away to barren islands and prepare them for human habitation" is called a "time-honored fancy." (I, p. 276) and again he says (II, p. 297): "A palm that is unable to maintain itself on the land has nothing to gain by having its nuts drifted about by the sea." It seems to me, however, that the restocking with plants of the islands in the Sunda Strait after the explosion in 1883 contradicts all these assertions, for both in Krakatau and in the small islands in its immediate vicinity that catastrophe involved the complete destruction of all organic life. This notwithstanding, Ernst([18]) informs us that at the time of his visit to those islands, only a few years after the cataclysm, "the large number of coconut palms" was "an especially remarkable feature." In the earliest visits to the devastated islands, Doctor Treub and Professor Penzig not only picked up coconuts which had been thrown up on the beaches by the waves, but also, very soon encountered coconut palms pushing their young green fronds through the soil; and in Plate IV, fig. 7, of Ernst's book a young coconut palm at the upper edge of the tide level (southeast coast of Krakatau) can be seen; in Plate VIII, fig. 11, an entire group of coconut palms is seen "towering above the other trees;" and of this group our author writes:

"To our great delight we found the coconut palms laden with fruit. The large number of ripe nuts on the ground, *several of which had germinated and produced plants reaching one meter in height*, showed that they must have attained the fruiting stage some years ago: a renewal of the forest is thus amply provided for. We were all refreshed by a quantity of unripe fruits which one of our Javanese companions brought down from the crowns of the palm trees." The same author on disembarking at Zwarte Hoek, likewise in Krakatau, writes: "Young coconut palms occur here and there with seedlings of *Barringtonia speciosa*, etc.;" and on page 68: "Groups of strand-plants have penetrated inland for a distance of 300-500 m." and among these are coconut palms. He adds that young coconut palms and *Pandanus* clumps are so near the edge of the sea that their stems are washed by the waves at high tide.

([18]) Ernst, A., The New Flora of the Volcanic Island of Krakatu, 58.

Another observation by Cook seems to me unsustainable; namely, that (I, p. 276) "the cocoanut palm seldom grows upon the immediate strand overhanging the water, or even in reach of ordinary waves." But everyone acquainted with the coasts of Asia and of the islands of the Malayan Archipelago and Polynesia knows the contrary to be the case. Cook himself (II, facing p. 299, Plate 54, fig. 1) gives an instructive illustration of "Coconut palms overhanging the surf at high tide, Puerto Barrios, Guatemala," and another half-tone from a photograph (fig. 2) of "Coconut palms overhanging the sea, Livingston, Guatemala." Against these assertions of Cook's one may oppose Ferguson's words:([19])

"The coconut tree flourishes better near the sea coast than in an inland situation. In such a vicinity it acquires more vigour, and produces with more fecundity; it never grows so luxuriant in the interior, where the air is not charged with saline particles, and salt water always seems to nourish it more than fresh water. The sea may wash the bottom of coconut trees without injury to them." And again, quoting Bertolacci, "It flourishes so very near the sea, that its roots are in many places washed by the waters without injury to the trees, until it is actually undermined."

As a result of my personal experience, also, all the arguments brought forward by Cook have not convinced me in the least that fruits of the coconut palm cannot be disseminated by the action of ocean currents, although he maintains (II, p. 324) that after his own observations no doubt can possibly remain that the contrary is the case. In fact he writes:

"For nearly two centuries the coconut has been described in books of travel and natural history, and even in formal scientific works, as an example of a plant widely distributed in nature through the agency of ocean currents." The following are also his words (II, p. 300): "The possibility that a coconut might be stranded on a newly formed island and multiply in the unoccupied soil, according to the fable, may not be absolutely excluded, but we know that the monopoly would not be of long duration." This, because the writer holds that young plants would be suffocated by "their forest-forming competitors."

I would observe, however, that these competitors on the sea shore would be only halophilous plants, which have never shown themselves to be incompatible with *Cocos nucifera*, especially on the sea beaches of coral islands, which are always in immediate contact with the sea. If on many continental and insular coasts of Asia the coconut palm is not met with, I would give among other reasons, which I shall state later, this one, that it is just because forest plants from the interior have found the means of forestalling or supplanting the strand plants which originate from drift seeds.

The coconut palm (always according to Cook) "cannot be disseminated by ocean currents." He says that (I, p. 277) "it is far from correct to suppose that all nuts [of the coconut palm] which reach the water are really launched for oceanic wanderings; the chances are still hundreds to one that they will be thrown back immediately upon their own coast, like other objects floating in the surf. High waves or tides, instead of floating shore debris away, merely carry it farther inland, as everybody familiar with seacoasts knows."

That there may be some coasts the surf on which has greater power of carrying away material than of bringing it thither, I admit; but that, as a general rule, the sea does not throw back floating

([19]) Ferguson, All about the Coconut Palm, 111.

objects of various kinds, including the fruits and seeds of plants, is undeniable. How could all the strand floras of the world have been formed, if the sea did not carry their seeds to the beaches by means of its currents? Furthermore, suppose it were true that the surf does carry objects inland, would not that be a favorable circumstances for the dissemination of fruits which have fallen on other beaches bathed by the same sea, or into the sea itself?

The Coconut Palm Does Not Always Stand in Need of the Assistance of Man

Cook believes (I, p. 280) that "human assistance" is necessary to the introduction and maintenance of the coconut palm, and he says (II, p. 296) that this palm "is not known to exist except as a cultivated plant;" and (II, p. 297) that "we should find old palms surrounded by flourishing young ones growing spontaneously without the aid of man." And again, "There seems to be no authentic record of coco palms establishing and maintaining themselves on any tropical coast in a wild or truly spontaneous condition." He adds that: "The complete absence of coconuts from the extensive tropical coast line of Australia until planted by European colonists" is, "a gigantic experiment showing that the coconut did not establish itself without human help, even in a place where it afterwards thrived in cultivation." Cook (II, p. 299) also quotes Pickering([20]) to the effect that "throughout the Pacific the coconut occurs only on those islands to which it has been carried by the natives." From another author([21]) Cook quotes: "It is to be emphasized that all coconuts are planted; the idea of a wild palm being as strange in Funafuti as that of a wild peach in England * * * I doubt whether, despite popular opinion to the contrary, a wild coconut palm can be found throughout the breadth of the Pacific."

That the assistance of man is necessary to the coconut palm is indubitable whenever it is cultivated in districts wherein there are not combined all the conditions of climate, etc., which its nature as a halophilous plant demands, and wherein it has to dispute the soil with other plants, or finds foes which injure its fruits when fallen to the ground or its young sprouting plants, or cause the death of the adult trees. But large groves of the coconut palm exist in a most flourishing condition in places where man most certainly does not contribute to their maintenance, and where they now produce themselves naturally, even supposing it were the case that the first fruits were deposited by man.

The Palmyra Islands are just such a case; there, as Darwin observed of the Keeling group, "the young and fully grown coconut trees grew intermingled with the adult plants."

It would appear that the same is the case on other coral islands of the Pacific; for examples, Palmerston Island and probably also Cocos Islands, formerly — that is, before they had been inhabited by Europeans. *Cocos nucifera* in these localities may be regarded as really wild and as a true representative of a strand flora; but admitting that the coconut palm, to establish itself on an oceanic island, has required, as a rule, the hand of man to carry its fruits thither, the case of the Palmyra Islands demonstrates that it is absolutely contrary to the truth to assert that the coconut palm can never flourish and reproduce itself spontaneously without the protection and help of man.

([20]) Pickering C., Chronological History of Plants (1879) 428.
([21]) Hedley, Australian Mus. Memoir 3 (1896) 22.

I cannot credit that even if the Polynesians did carry the coconut to the Palmyra Islands, they ever returned thither to take care of the plants. Yet the coconuts of the Palmyras are among the largest and finest known, and their albumen is more developed than that of most varieties cultivated by man. On oceanic islands, and especially on atolls, the coconut palm can establish itself; because when once the waves have deposited the fruits the young plants do not have to fear any competition with the primitive forest for the soil, and also because their competitors can at worst be only a few halophilous plants, produced from seeds brought thither at the same time as themselves, which can not oppose any great resistance to the growth of the coconut palm. Moreover, a most essential matter, no destructive marauders can have existed in such islands; while, on account of their great isolation, not even the foes of the coconut tree that are most to be dreaded — the red and the black beetles — have been able to reach them. Still arguing to sustain his theory, Cook writes (II, p. 303): "Unless the human friends of the young coconut are at hand to keep down the other vegetation the period of infancy is not survived." But it must be observed that the special conditions, required for the coconut palm to develop and reproduce itself independently of man, are just those found either on newly emergent beaches, such as those of Krakatau, or on the oceanic islands on which grow only a few species of plants born from drift fruits, and on which there exists no animal likely to be hurtful.

But if one holds as correct Cook's assertion, that *Cocos nucifera* cannot have developed its actual qualities without man's protection except in America, we must admit that the cradle of mankind was America; for Cook is right when he says "that the useful cultivated plants offer the best record of man's primitive existence." If this *Cocos* cannot live without man's protection and if man must necessarily have been its distributor, we must also admit, either that man was the creator of the species *Cocos nucifera*, or that man appeared on earth at least contemporaneously with *Cocos nucifera*. The fact that the coconut palm has not established itself in Australia without help, although its nuts must certainly have been carried to its shores, can be understood when we consider that Australia is one of those regions where the conditions are precisely such that the coconut could not establish itself without man's assistance; such conditions are the predominant vegetation; the too great dryness, especially during the period of germination; and the presence of animals destructive to nuts and to young and to full-grown plants.

Cook finds another argument for maintaining that the coconut palm cannot have disseminated itself in the asserted fact that its fruits, falling from such a height, must surely be injured by the cracking of the kernel, which would have the effect of reducing "materially the chances of successful germination." But even if this were true (and in the case of some very tall palms it may perhaps happen), this must also have been the case in the birthplace of the coconut palm where there was no man ready, as he says, "to let the fruits down carefully to avoid injury" to them. Setting aside the small probability of such peril, it must be remembered that the coconut palm begins to fructify when only a few meters high; therefore, there is no danger whatever that its fruits will be injured by their fall or that there will not remain a sufficient number of them to secure the reproduction of the species.

The Coral Islands are the Locality Best Adapted to the Spontaneous Reproduction of the Coconut Palm

The manner in which the volcanic island of Krakatau (whence every slightest trace of vegetation was swept away by the explosion) has been restocked with plants, under our eyes, reveals the manner by which the coral islands can have been populated with a new flora, as soon as they were in a condition to sustain a vegetation.

The transportation of seeds of plants to these coral islands may have been effected otherwise than by the usual ocean currents, by means of extraordinarily violent storms, by exceptionally high tides, and by the great waves that are occasionally produced by telluric movements, and which are of no rare occurrence in that part of the Pacific, wherein a good number of islands appear to rest on volcanic bases. It does not seem likely that other forces, such as the winds, or birds, or other fruit-eating animals, have contributed much to populate certain coral islands (the Palmyras amongst others) with flowering plants; because the seeds that might have been carried to them by these means belong almost wholly to species that do not tolerate the presence of salt in the soil and often not even in the air.

The oceanic coral islands of new formation can be populated only by plants of which the seeds, besides being able to float, possess also outer wrappings of such a nature that they can resist the action of salt water, and which, moreover, can tolerate the presence of salt during the period of germination; thus is explained the scanty number of plants found on oceanic islands, which, like the Keelings and the Palmyras, cannot be regarded as being the relics of ancient drowned lands.

The Palmyra Islands belong in fact, like the Keelings, to those islands constituted entirely of coral, of which Darwin wrote, as quoted by Hemsley,([22]) that they "at one time, must have existed as mere water-washed reefs," and to which all the terrestrial products that existed on them, before Europeans settled on them and even before any natives had reached them, "must have been transported by the waves of the sea."

It is precisely on account of this circumstance that I maintain that the coconut palm has been able to establish itself, unaided by man, both in the Palmyras and in the Keelings and, probably, in other islands, not well known to us. Indeed, it is on islands of this kind and on their scanty soil, almost level with the water, that any coconut which may have been washed up on the beach and been able to germinate, finding no hindrances nor obstacles in any pre-existing forest vegetation, would have been able to grow and prosper, because it did not find there the many enemies which would have hindered its independent development on the shores of a continent or on one of the great Asiatic islands.

Among the most dreaded foes of *Cocos nucifera*, the wild hogs must be reckoned. With respect to these we read in Ferguson([23]) an extract from the Ceylon Examiner as follows:

"Amongst the enemies of the coconut tree the wild pig has the first place. Not only because he is the most destructive to young plantations, I suppose, but because he is about the earliest enemy that the plant has to contend against."

It is certain that on the coasts of Asia and on the shores of the Malayan and

([22]) Report of the Voyage of H.M.S. Challenger, Bot. 1 (1885), The South-Eastern Moluccas, 114.
([23]) All about the Coconut, 137.

Papuan islands, where the wild pig is excessively abundant, not a single coconut would succeed in producing an adult plant without the protection of man, even though all the other conditions were favorable. There are besides the pigs other mammals such as certain rodents and herbivorous marsupials, which are very injurious to the coconut; among the last I learn that in New Guinea the "little flying opossum" (*Belidens ariel*) is in the habit of completely emptying the ripe nuts. It is noteworthy, also, that whole plantations of coconut palms can be utterly ruined by the injury caused to the adult plant by two very dangerous insects, the red beetle (*Rhynchophorus ferrugineus*) and the black beetle (*Oryctes rhinoceros*).([24])

That the coconut palm not only can exist, but can prosper without man's help and can even produce finer and larger fruits than in places where it is carefully cultivated, is clearly evidenced by the dimensions of the coconuts of the Palmyras which I have already described. This fact may be attributed to the very special conditions inherent in the soil of the Palmyras; for though at first sight one would be inclined to think that *Cocos nucifera*, which is so exacting a plant as to fertilizing elements, could draw very little aliment from a soil composed solely of disintegrated coralline rock, of which rock the islands are formed, it does in fact find abundant nutrition therein.

([24]) How the presence of an insect can impede the acclimatization of a plant in a new region, the following fact demonstrates. For several years I cultivated *Aubrietia deltoidea*, a pretty *Cruciferae*, native to southern Italy, but unknown in Tuscany, which maintained and multiplied itself upon a rockery without any help, in my garden near Florence; until it was attacked one spring by the larva of a small beetle, *Ademonia tanaceti*, which devoured it to its last leaf, since which it has never reappeared.

The fact is that in coral islands, in addition to the detritus of various kinds, all capable of being transformed into humus, which the sea may have brought to them, the soil which forms upon them may contain fertilizing substances due to the remains of animals that have contributed to the formation of the reef; to the accumulation of guano deposited by sea birds; and finally to the remains of the innumerable mollusks and crustaceans by which coral islands are usually populated.

The Coconut Palm a Halophilous Plant Peculiarly Adapted to Tropical Sea Coasts and to Oceanic Dispersal

A chemical analysis of the ashes of the coconut palm shows that all its organs contain chloride of sodium in considerable quantity; this salt, indeed, after the salts of potassium and of lime and the phosphates, being their most abundant constituent; it is even more abundant than silica, which in the state of crystals is found to be especially abundant in the leaves.

According to the summing up of Prudhomme,([25]) a plantation of 1 hectare of the coconut palm annually draws out of the soil 120 kilograms of marine salt. And from Ferguson's report([26]) we learn that an adult plant requires each year 1.34 kilograms of chloride of sodium. Salt, therefore, is considered an important manure for the coconut palm — far more than the quantity found in its ashes appears to demonstrate.

From the same source I learn that Doctor Gardner, to show the value that the Brasilians attribute to salt as a fertilizer for coconuts, states that "a man would walk many miles for it, pay high for a load, and then apply it to a single tree." Elsewhere, it is stated that sea

([25]) Le Cocotier, 262.
([26]) Op. cit. 66.

weeds and the ashes of plants that contain much salt are used as manures for the coconut palm. Ferguson also states (p. 142) that the Singhalese "invariably throw a little salt into the holes before they place the coconut plants in them." And on page 111, speaking of a new plantation of coconuts which is being made inland and at a distance from the sea, he says: "it is customary to throw a considerable quantity, as much as half a bushel, of salt into the hole which receives the coconuts.

Prudhomme,([27]) writing of the toleration of the coconut palm for marine salt, asks if marine salt should not be reckoned among the fertilizers to be administered to this palm, as it seemed to him, that instead of merely tolerating it, the coconut had a real preference for this salt. The excessive toxicity of sodium chloride for plants is well known; the coconut palm, however, is one of the few that can live on a salt soil. For that reason I am not able to understand how a plant endowed with such high hereditary halophitism — which, therefore, not only tolerates, but actually prefers, a salt soil and, moreover bears fruit so constituted as to be, as Seeman([28]) writes, "often tossed about the ocean for months without losing its germinating power from the effects of salt water" — can have been plasmed or brought into existence in a region remote from the sea.

That *Cocos nucifera* is a true halophyte, that is to say, a plant capable of resisting the physiological action of mediums rich in chloride of sodium and in the other salts that are characteristic of sea water, the very presence of which is pernicious to most other types of vegetation, shows that it must have been placed in close contact with salt soils during the period of its evolution; considering, therefore, all the other circumstances that may have been required during and for the evolution and plasmation of the species *Cocos nucifera*, we are led to conclude that it must have originated on maritime shores.

Few are the true halophytes, and for this reason the flora of maritime shores and of the coral islands is poor in species, but in compensation they are of extremely wide geographic distribution. And this is because there are few plants having seeds tolerant of salt and at the same time provided with fruits capable of floating and of enduring a long immersion in salt water and, hence, fitted for long voyages. The coconut palm is one of these few. It is true that this palm can grow and even prosper far from the sea and can exist at a certain elevation above it, but it is probable that in these localities it can always find the quantity of chloride of sodium it needs. But although it is true that the coconut palm is capable of adapting itself to non-saline soils, as other halophilous plants can do, it none the less remains true that if *Cocos nucifera* were not a plant of the sea shore, and therefore an indubitable hereditary halophyte, it would not be better suited by a soil rich in chloride of sodium than by a soil devoid of that salt. It was therefore on the shores of the sea and especially on those of the coral islands that *Cocos nucifera* must have found the conditions under which it assumed its present specific characters: because there it would have had little to fear from the competition of other large plants of the strand flora and because there, also, it had not to struggle against powerful foes. Therefore, it cannot be admitted that the coconut palm is "unable to maintain itself on the sea coasts," and "the popular idea" that the "coconut palm is a plant specially adapted to

([27]) Le Cocotier, 40.
([28]) Fl. Vit. 276.

tropical sea coasts" is, and remains, a true idea.

Conclusions

From the preceding study, which was chiefly suggested to me by the conditions in which the Palmyra Islands were found by their explorers, Messrs. H. E. Cooper and J. F. Rock, I conclude:

1. That the coconut palm may have been very easily disseminated by the agency of oceanic currents.
2. That the coconut palm is a halophilous plant with a predilection for the sea shore.
3. That an Asiatic or Polynesian origin of the coconut palm is more probable than an American one.
4. That the coconut palm can occasionally exist and reproduce itself in the tropics independently of man, and that the latter's protection is necessary to it only when it occurs in regions wherein its existence is disputed by the nature of the soil, by other pre-existing vegetation, or by foes of various kinds.

THE EDITOR'S CORNER

The present issue of PRINCIPES contains an article by Beccari which several persons have suggested be reprinted. The original intent was to divide it between two issues, but upon thought such a division seemed inadvisable. Thus it is reprinted in its entirety, together with the summary of O. F. Cook's arguments about the origin of the coconut, at the risk of an overdue emphasis on the coconut in one issue.

It should be noted that some of Beccari's observations concerning the classification of palms related to *Cocos*, and particularly *Eugeissona*, would perhaps be modified by contemporary writers.

The Editor also wishes to note that the authorship of "What's in a Name?" should have been credited to Bruce H. Beeler in the January issue page 34.

USES OF COCO-DE-MER TREE

The stem does not find any use as the wood is rather soft and is liable to rot easily. It is therefore useless as a source of timber.

The leaves provide a first class material for thatching purposes. They are so large that only a few are sufficient to cover a native hut completely.

The young leaves are used on a large scale for making the beautiful straw hats which are worn by a large fraction of the population. They enter also in the composition of the coco-de-mer mats and baskets which are turned out in large numbers by expert hands.

The fruit is eaten at an early stage during its development.

The nuts are exported and sold in the East, where the endosperm is reputed for its medicinal properties. Arabs and Indians use it as a tonic, an aphrodisiac, and a poison antidote.

It is a pity that attempts to use the endosperm as vegetable ivory failed on account of the ease with which it cracks. Professor Pieraets of Brussels tried his best to overcome this difficulty but unfortunately his attempts to produce a commercial product from the endosperm failed.

The shell of the nut is put to various uses: water bottles, fruit bowls, bowls for baling, plates, etc., etc.

The plates and dishes of coco-de-mer are well known objects in the Praslin crockery. Bowls for baling form the equipment of every boat and "pirogue."

The bowls produced when the lobes of the nut are cut parallel to the sinus are well known in Mauritius where shopkeepers use them for measuring out rice or sugar.

At one time the bowls were quite useful in Mauritius sugar factories where

they were used to scoop out sugar from the centrifugals.

Pilgrims on their way to Mecca are supposed to eat their food from utensils produced by nature and there again the coco-de-mer bowls become of some use.

[From F. Durocher Yvon, "Seychelles Botanical Treasure: 'The Coco-de-Mer' Palm (*Lodoicea maldivica*, Pers.)" in Revue Agricole de l'Ile Maurice 26: 86. 1947].

WHAT'S IN A NAME?

Ammandra am án dra is a relative of *Phytelephas* in which, according to O. F. Cook, "The stamens are minute and have the appearance of small grains of sand scattered over the surface of the receptacles, thus suggesting the generic name *Ammandra.*" The name was formed from the Greek *ammos* (sand) and a modification of *aner* (man) since the stamens are the male elements of the plant.

* * *

Palandra (pal an dra) is another relative of *Phytelephas* with a name apparently derived from the Greek *pas (pal-)* meaning all, the whole, very, and a modification of *aner*, man. Cook unfortunately did not explain the origin of the name but perhaps it refers to the very many stamens (about 1000).

H. E. Moore, Jr.

Toddy Collection in Ceylon

W. H. Hodge

National Science Foundation, Washington, 25, D. C.

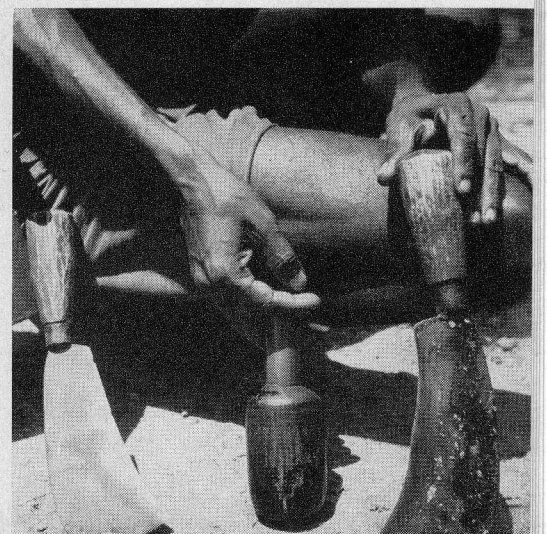
Toddy, the sweet fresh sap of palm trees is a familiar beverage consumed daily by the country folks in many parts of tropical Asia — especially India, Ceylon, Malaya and Indonesia. Best known source is the toddy palm, *Caryota urens* (familiar to us as one of the attractive fishtail palms of ornamental horticulture), but several other species are also valued for their sugary sap, including the palmyra palm, *Borassus flabellifer*, the gomuti palm, *Arenga pinnata*, as well as the tropics' omnipresent coconut palm, *Cocos nucifera*. In all these species the sap is obtained by tapping the young unopened inflorescence, or spadix. As this appears as a tender bud from the leaf axilla the tip is cut off and the oozing liquid is then collected in a container, from which it is collected daily.

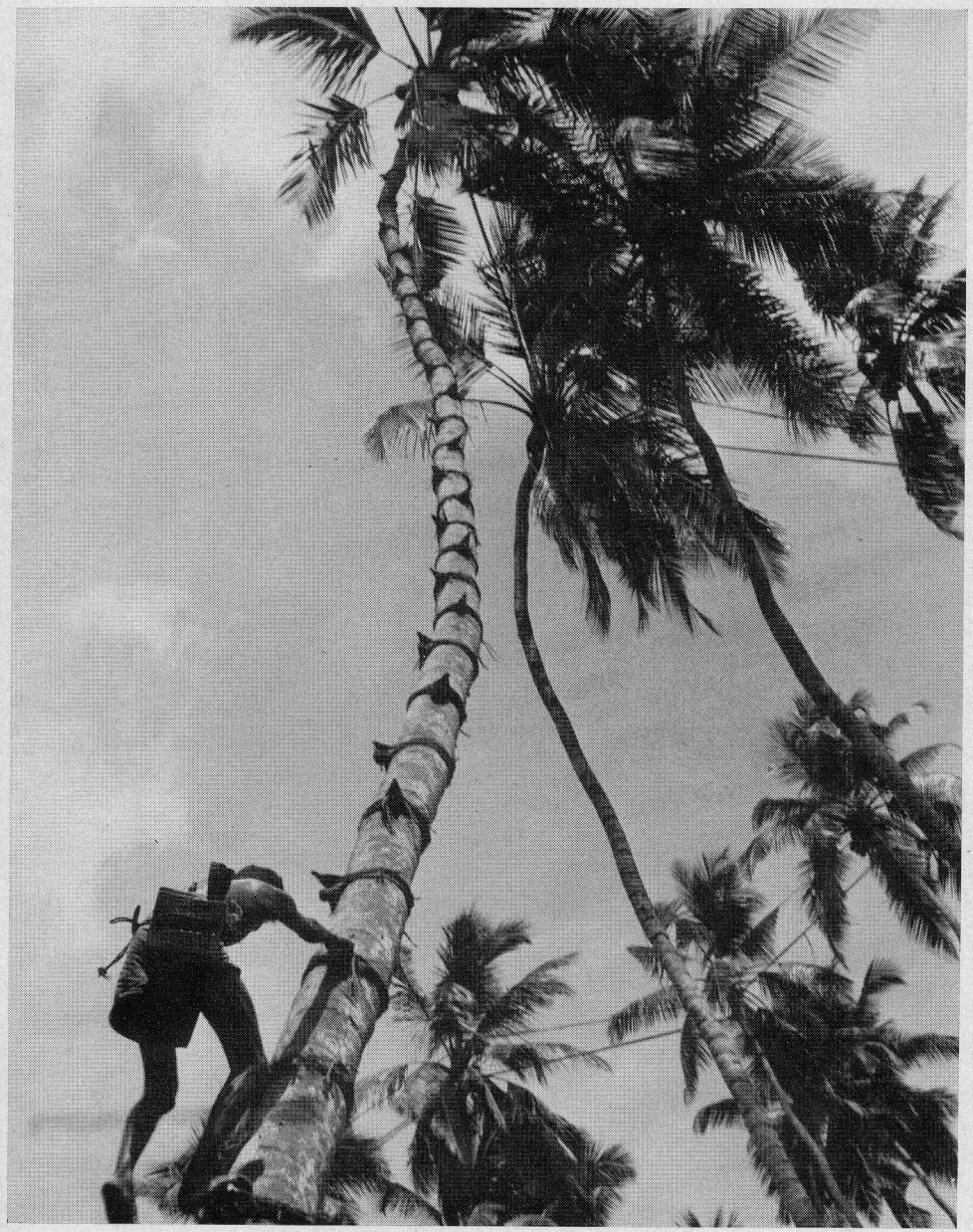
Although abundant palm species native to the New World might well have been tapped to produce a toddy, apparently the utilization of this fresh liquid was never developed among American aborigines who were familiar, however, with the production of palm wine. In contrast toddy has probably been utilized by man in Asia for a very long period. Marco Polo, in the 13th century, was among the first European travelers to briefly describe toddy production (on the island of Sumatra, "Kingdom of Samara"). In Book III of his Travels he writes: "Wine is not made; but from a species of tree resembling

50. Toddy gatherers of the Kalutra coast of southwestern Ceylon together with paraphernalia for collecting.

the date-bearing palm [gomuti palm, *Arenga pinnata*] they procure an excellent beverage in the following manner. They cut off a branch [actually the developing inflorescence], and put over the opening a vessel to receive the juice as it distils from the wound. This is filled in the course of a day and a night. So wholesome are the qualities of this liquor, that it affords relief in dropsical complaints, as well as in those of the lungs and of the spleen. When these shoots that have been cut are perceived not to yield any more juice, they contrive

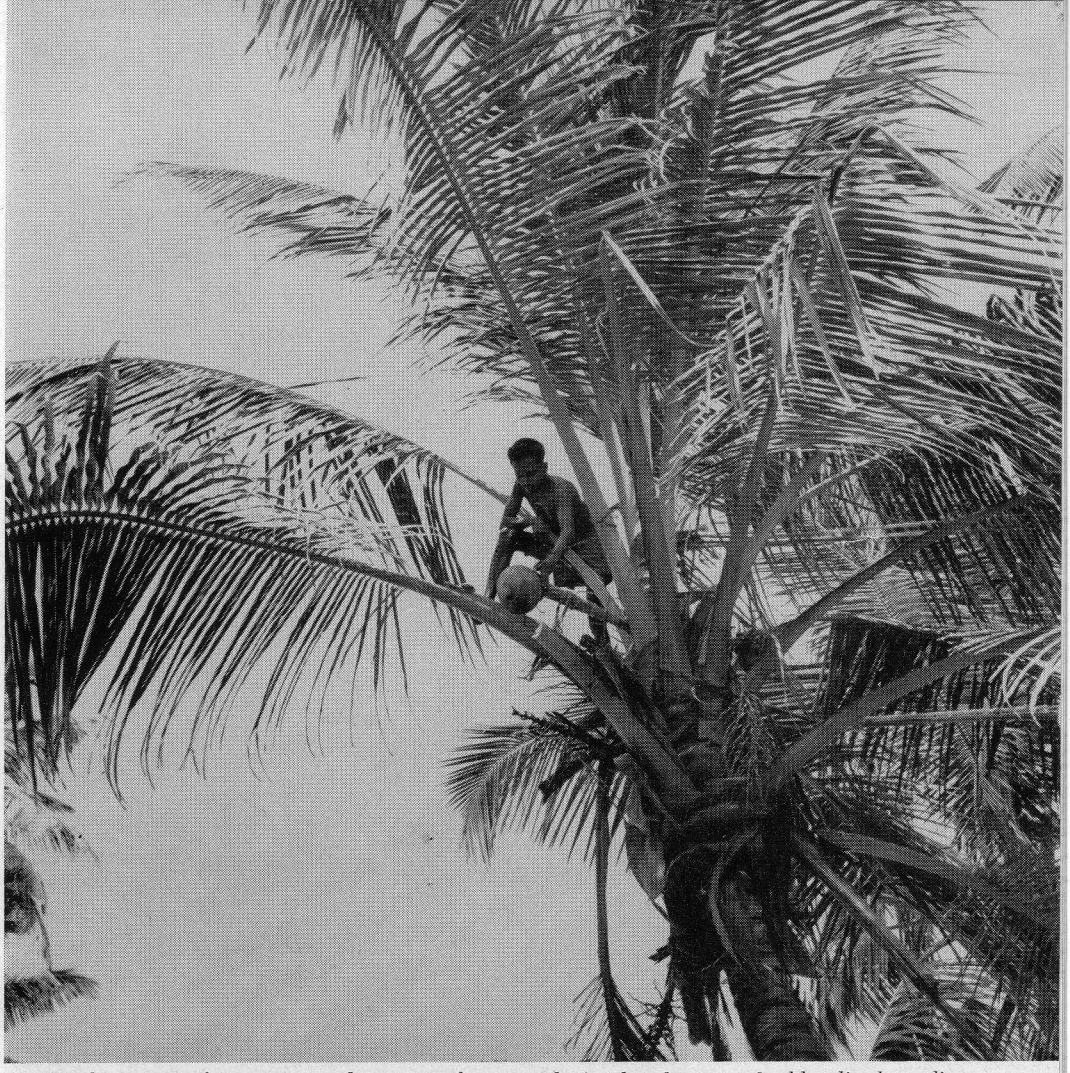
51. Tools of the toddy gatherers's trade—wooden mallet for gentle beating of young spadices, and knives for slicing spadices.





52. With tools strapped in a box at waist level, the toddy gatherer ascends the ladder tree from which catwalks of coir rope radiate to other parts of the grove.

to water the trees, by bringing from the river, in pipes or channels, so much water as is sufficient for the purpose; and upon this being done, the juice runs again as it did at first. Some trees naturally yield it of a reddish, and others of a pale colour." Later Polo records the same use of toddy from Ceylon ("Zeilan").



53. In the crown of a coconut palm, a gourd receptacle is placed over a freshly sliced spadix.

Four centuries later in his *Historical Relation of Ceylon* (1681) the Englishman, Robert Knox, mentions toddy production from the "kettule" palm (*Caryota* sp.) which, he says, "yieldeth a sort of liquor, which they call Telligie: it is rarely sweet and pleasing to the Pallate, and as wholsome to the Body, but no stronger than water. They take it down from the tree twice, and from some good trees thrice, in a day. An ordinary tree will yield some three, some four gallons in a day, some more and some less . . . The manner how they take this liquor from the tree is thus; When the tree is come to maturity, first out of the very top there cometh out a bud, which if they let it grow, will bear a round fruit, which is the seed it yieldeth, but is only good to set for encrease. This bud they cut and prepare, by putting to it several sorts of things, as Salt, Pepper, Lemons, Garlick, Leakes, etc., which keeps it at a stand, and suffers it not to ripen. So they daily cut off a thin slice off the end, and the liquor drops down in a pot, which they hang to catch it."

Obviously Ceylon has been a source of toddy production since ancient times. The major toddy producing genera today include the trio *Borassus flabellifer*, *Caryota* sp. and *Cocos nucifera*, the

54, 55. A gourd-full of freshly collected toddy is lowered by rope from palm top to assistant on ground who gathers the liquid into a wooden bucket.

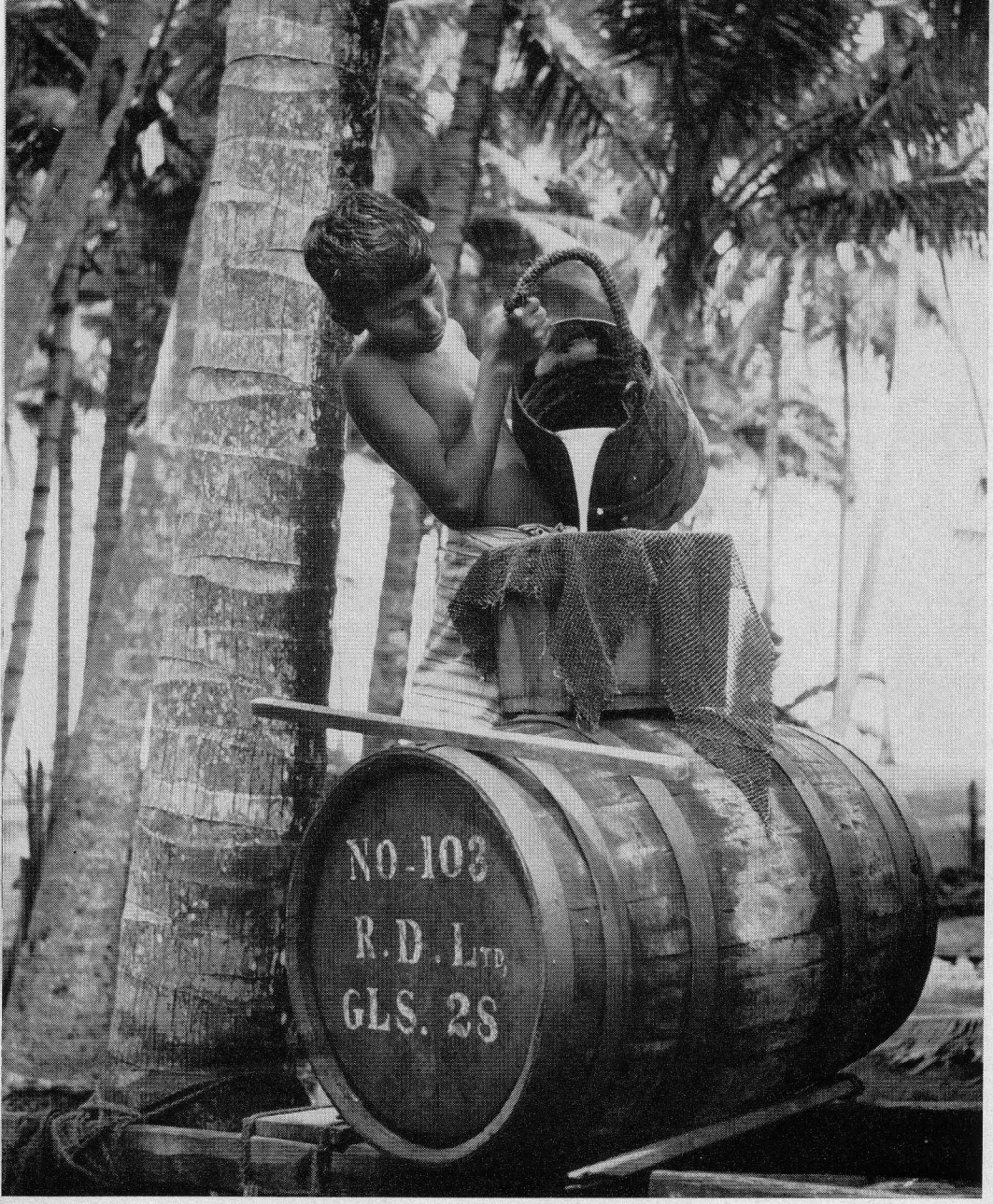
common coconut. In the Kalutra District of Ceylon's southwest coast the extensive coconut groves are also prime sources of toddy. Indeed, this is said to be one of the most important toddy production centers on the island. Here the stands of lofty coconut palms demand special techniques in collecting and these have been developed by the local toddy collectors to whom the daily gathering of the milky sap is a profession said to be handed down from father to son.

Several years ago in the little village of Indrilidoda, some 25 miles south of Colombo, I was amazed to see the 60-80-foot high crowns of the roadside coconuts interlaced with ropes. Upon enquiry I learned that these were the aerial catwalks of the local toddy collectors

who, several times daily, risk their lives high in the swaying palm-tops as they make their rounds collecting fresh coconut sap. Later I had the pleasure of observing a local toddy collector at work and from him were gleaned some interesting facts about his unusual trade.

Because team work is a prerequisite (to save undue climbing in mature coconut groves) toddy collectors work in pairs — one to travel the aerial rope walks, the other to service his comrade from the ground. Our pair at Indrilidoda was a barefooted man and boy, both naked to the waist, the former in shorts — the better not to impede his climbing, the boy with a simple wrap-around sari. On his chest, at collarbone level, the adult aerialist sported tatooing in attractive Singhalese characters. In response to my enquiry as to the meaning of this indelible inscription I was told it simply meant "The carefree life"! What life could be more carefree than to spend much of one's daylight hours clambering bird-like through the swaying tops of palm trees! The tools of this profession appeared relatively simple, and were carried in a wooden box strapped to a belt carried around his hips. Tools included a pair of broad-bladed steel knives resembling somewhat the curve-bladed knife used for cutting linoleum; the Singhalese equivalent are utilized for slicing the palm spadices. Besides the knives was a small wooden mallet with which the young inflorescence stalk (spadix) is gently beaten a few days prior to tapping. A long coil of coir rope, to which was hung a large gourd, completed the gear and served not only to gather fresh toddy accumulated since the last collection in the palm tops but also to pass it down as required to the assistant whose simple wood bucket served as receptacle and carry-all for the liquid in its path from palm top to the wooden cask into which toddy is ultimately collected.

Coconut palms become toddy producers as soon as they start flowering. At this time abundant sugary sap, needed for the rapid growth of flowers and fruits, starts flowing into the developing inflorescences. To steal this sap from the palm is the objective of the toddy collector, but only strong healthy trees are utilized. Since flowering starts when the palms are still low-statured (7-8 years from seed) collectors can for a time gather toddy from near ground level. With increasing height of the palms squirrel-like agility becomes necessary — as well as an assistant on the ground. Once flowering begins in the coconut palm it continues at short intervals for the lifetime of the tree, the result being the more or less continuous production of fruits with a corresponding constant flow of sap to aid their development. In a toddy-producing grove nuts of course never appear, for the young flower cluster — even before it has had time to push out of its green protective spathe — is severed by the knife of the toddy gatherer permitting flow of the sap from the conducting tissues into the collecting vessels. To facilitate collection of the sap the severed stalks are pounded at their tips with a mallet and the enveloping spathe is trimmed and tied so as to serve as a spout to lead the liquid into the gourd receptacle. In some areas lime is apparently smeared on the inner surface of the vessel to prevent souring and fermentation. An individual coconut palm may be tapped daily for a period of several months — or until the tapped spadices have been cut back completely; but, depending upon the climate, overall tapping of a toddy grove usually continues for six to eight months a year. The yield per tree for such a period runs



56. The fresh toddy is strained through a cloth and funnel into a wooden barrel for transport.

to 40 or more gallons of toddy. Since the surface of a producing spadix tends to callus over rapidly the wound must be reopened regularly. This results in regular visits of the toddy collectors whose job it is to shave daily and bruise the cut ends of the producing stalks so that a continual flow of sap is assured.

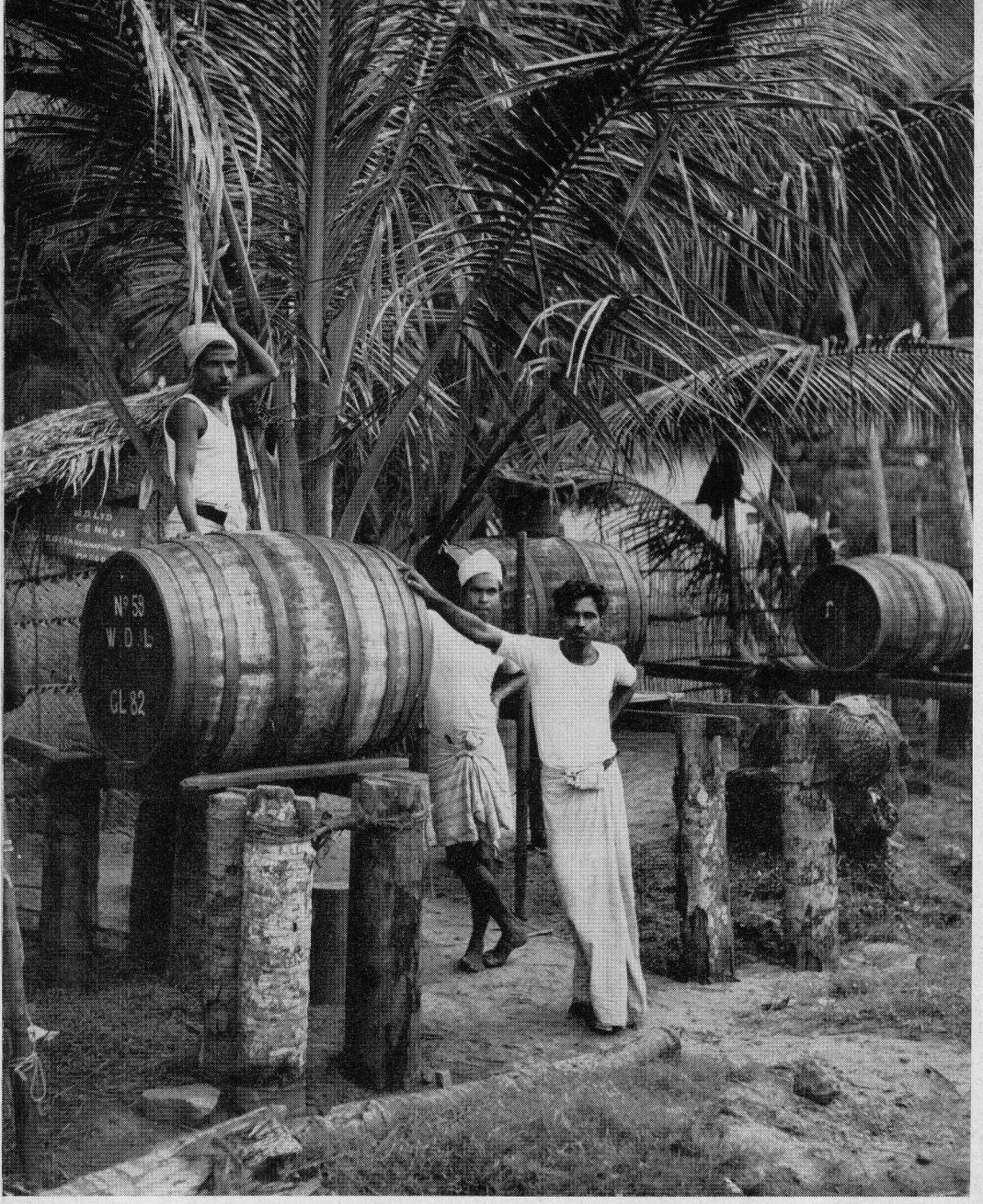
The daily routine of toddy gathering begins shortly after daybreak at which time all trees (perhaps from 50 to 100) in charge of a single gatherer must be visited and the toddy accumulated during the preceding 12-24 hours is collected. At the same time the collector may tap anew, scraping or cutting off

enough of the drying surface to stimulate continued flow. He will also prepare newly appearing spadices for eventual tapping by beating them with his mallet. In the early afternoon another visit may be made to continue tapping and/or collecting but normally 24 hour intervals appear to ensue between collections.

Such daily work is one reason for streamlining the tree top activity in the toddy producing palm groves. As young coconut palms mature and gain height the problem of clambering into each producing crown is a serious one. To lighten the amount of climbing needed, ropewalks have been developed enabling collectors to pass from tree to tree without having to descend until all crowns have been visited. One conveniently located tree is singled out to serve as a permanent ladder for all ascents and descents and from this palm ropeways are strung to neighboring palms — usually several score or more. To facilitate climbing the fibrous coconut palm, leaf petioles are slit down the middle as far as the woody flaring base which is allowed to remain more or less whole while the fibrous lengths remain as ropes to tie each base around the bole as one step or rung of a crude ladder. A series of such steps is all our toddy collector needs to reach his aerial rope walks. The latter, also made of coir, are usually three strand affairs. A heavier basal strand is used as the footpath while twin strands paralleling the other at chest level serve as a double hand hold to the worker traversing the walkway from palm to palm. As a worker's collecting receptacle is filled from the numerous tree top containers, it is let down by a coir rope to the assistant below who empties the milky contents into a bucket. Once full, the latter is carried for straining through a wood funnel into a large but standard sized barrel used to store the raw liquid until it is taken to market or distillery.

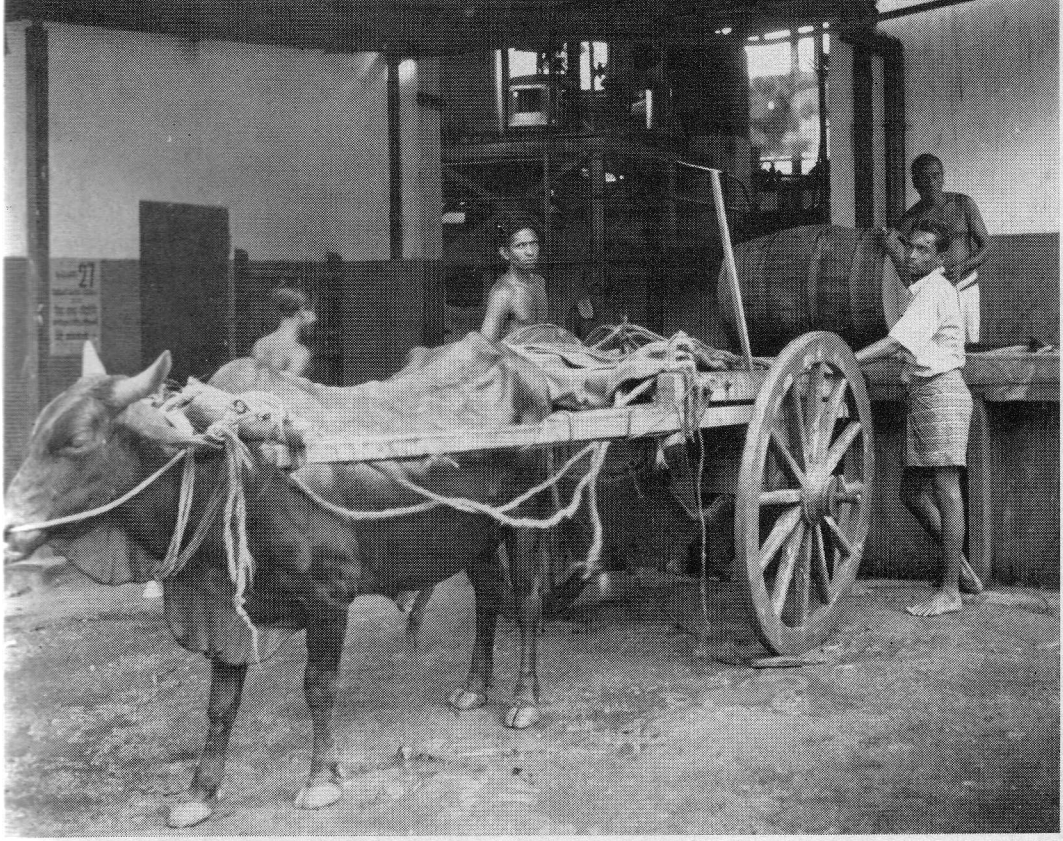
Sampling of the milk-like toddy reveals a pleasant sweetish flavor with just a bit of a savor of vinegar. Fresh toddy must be consumed soon for after a relatively short time (24 hours) it begins to ferment producing a sour beverage said to be unfit to drink. Prior to European contacts with the island, the alcoholic properties of toddy were not generally utilized, for intoxicating drinks were anathema in Buddhist Ceylon. Indeed, Robert Knox emphasized this fact when he wrote "Drunkenness they do greatly abhor, neither are there many that do give themselves to it;" and further, "their common drink is only water." Thus although toddy is today recognized as a palatable beverage it was produced in the past primarily as the source of brownish palm sugar or "jaggery" which was obtained simply by boiling down the liquid — much in the same manner as one obtains a similar sugar from maple (*Acer*) sap.

The opening of Ceylon to westerners through contacts with Portuguese, English and Dutch traders — a number of whom, like Knox, were held captive by one of the 17th century Kings of Kandy — helped to break up the traditional Kandyan sanction against spiritous liquor. Europeans of the time apparently liked their liquor and the King of Kandy's European captives were no exception and soon learned how to distill the most readily available liquor source, fermented toddy. The result was the production of "arrack" which is now commonplace in contemporary Ceylon, though under government control. Thus the toddy gatherers of Kalutra whom I had such pleasure in observing were primarily tapping their coconut plantings for the production of "arrack" at local distilleries. For this reason the



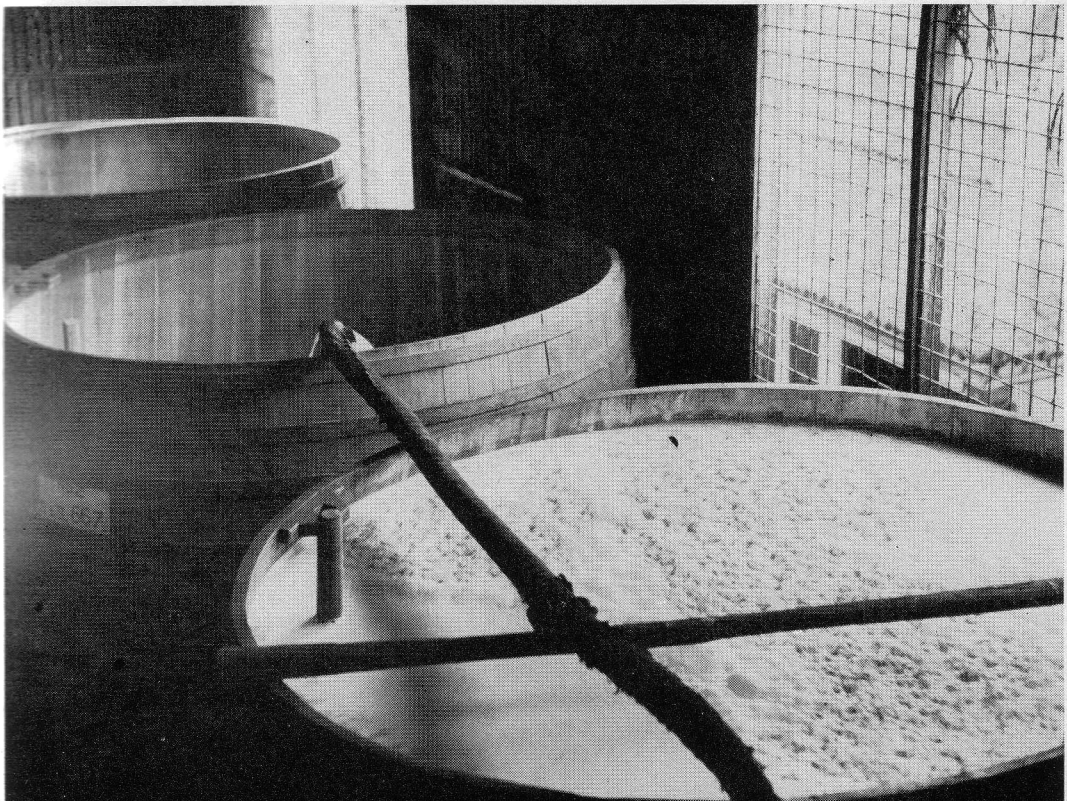
57. Roadside depots for barrels of freshly gathered toddy.

fresh toddy was filtered and funnelled into heavy wooden barrels for transport to distillery. Barrel-gathering depots were common along the coastal by-ways and were of such a height to permit easy loading of the barrels onto the 2-wheeled bullock carts used to bring the toddy to its journey's end at the distillery. There it undergoes four to five days fermentation prior to distillation. According to one source six and one-half to seven gallons of toddy produce about one gallon of arrack of 25 degrees under proof. Like many distilled beverages, arrack improves with age, old spirit bringing the highest prices.



58. Toddy arrives at a Ceylon distillery by bullock cart.

59. Toddy fermenting in vats at the distillery.



60. Tall and graceful *Euterpe precatoria* accents the forest near Iberia, Peru. Photo H. E. Moore.