Branching in Palms.

BY

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With Plates XXXIV–XXXIX.

THE occurrence of abnormal branching of the stem in certain palms has not unfrequently been recorded and figured in a variety of publications, and most of what had been recorded was summed up by Dr. Daniel Morris in his paper 'On the Phenomena concerned in the Production of Forked and Branched Palms' (Journ. Linn. Soc., xxix (1892), p. 281). Having had for eighteen years the opportunity of observing these abnormalities in the Eastern tropics in palms both wild and cultivated, I am enabled to add some descriptions of branching and the production of bulbils in various kinds of palms.

Morris describes the growth of palms as the continuous development of a single monopodial bud, and says that palms have normally an unbranched caudex; but I believe that the greater number of palms are really branched at the base at least, and that cases where there is but one axis produced are rather a departure from the normal.

In many genera we find palms which never produce more than one stem from a single seed, side by side with others which habitually produce lateral buds. Thus we have :—

With one stem.	With several stems.
Caryota urens.	*C. mitis.*
Euterpe oleracea.	*E. stenophylla.*
Areca Catechu.	*A. triandra.*
Raphia Ruffia.	*R. Hookeri.*
Cocos nucifera.	*C. plumosa* (occasionally).

The commonest form of growth in palms is that seen in the soboli-

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ferous species which send out one after another lateral buds from the base, and these ascending become erect stems, so that the whole plant eventually forms a bush. Such are the rattans (*Calamus*, *Plectocomia*, *Zalacca*, and others), *Oncosperma*, *Pinanga*, and others. Then we have a certain number in which some of these shoots grow for a considerable distance, usually under ground, and produce lateral stems at intervals. *Rhapis flabellifera* is an example of this. It throws out slender subterranean suckers to some distance which send up erect leafy stems. In connexion with this plant, commonly cultivated in Singapore, I may remark in passing that the only instance known of its flowering and fruiting is that of a cutting from a rhizome, which on being planted grew out into one poor stem that flowered and fruited several times but never threw up a second stem during the period of observation.

A species of *Pinanga*, perhaps *P. patula*, long cultivated in Singapore, has also subterranean stems which throw up erect leafy branches.

In the two tidal mud palms *Metroxylon* and *Nipa* a large branched rhizome is produced, of a somewhat fleshy nature. This lies half buried in the mud or in drier spots upon the surface of the ground, and produces axillary buds. Some of these ascend and form the tall erect stems in *Metroxylon*, while others, slowly developing, produce the rhizome-branches, from which again ascending stems are developed. This form of palm, although the stems bear pseudo-terminal inflorescences and die after flowering, cannot be called monocarpic in the sense that *Corypha* is a monocarpic palm, as the main stem (the rhizome) does not die, and only the branches are monocarpic.

Morris, in his paper referred to, regards as branched only palms that have divisions of the main stem near the apex, but there is no reason for excluding from the category those that throw out lateral shoots even low down on an ascending stem, which shoots ascend and eventually become often as large as the original stem from which they grew. About twelve years ago, in a clump of *Oncosperma filamentosa* a shoot was thrown out from an erect stem about a foot from the base. It is now (1906) developed into a full-sized erect stem, parallel with the original stem, so that the appearance is that of an equally forked stem, bifurcating a foot from the ground. In many of these developments of lateral buds from the erect stems the growth only lasts for a few years, and the buds die off and disappear, but occasionally, as in the case of this *Oncosperma*, they develop into erect stems.

In the summary of his paper, Morris draws the conclusion that—

1. The branching is due to the injury or destruction of the terminal bud. This may be, and is certainly sometimes the case, in the date palms (*Phoenix*), but is certainly not always or even commonly so in other palms; I never saw an instance in which dichotomy of the

apex occurred, nor one in which the central original bud was crushed out by the development of two lateral ones. In all cases of bifurcation or apparent bifurcation which it has been possible to investigate, one of the branches is a lateral bud, often produced low down on an already tall main stem, and the axillary bud has grown so rapidly that it in time equals the original one in height and thickness.

2. Palms which are usually soboliferous (i. e. produce suckers at the base) are rarely branched at or near the base. Soboliferous palms, however, have a distinct tendency to emit axillary buds well above the base of the main stems, as in the case of the *Oncosperma* above described, and I have seen the same thing in *Dypsis pinnatifrons* and *Chrysalidocarpus lutescens*, both soboliferous palms, as well as in rattans of two genera.

3. No instance appears to be recorded of a monocarpic palm with a branched stem. He defines as a monocarpic palm one which has a terminal inflorescence appearing once only; after the plant has flowered and ripened its fruit it dies. He classes as monocarpic: *Metroxylon*, *Corypha*, *Raphia*, *Caryota*, *Ancistrophyllum*, *Plectocomia*, *Eugeissona*, and possibly *Arenga*. Of these the only ones which are strictly monocarpic are *Corypha* (all species), *Raphia Ruffia*, and perhaps some species of *Metroxylon*.

Plectocomia and *Eugeissona* are very long-lived plants, of which the branches flower in turn and die, but the plant does not. The *Caryotidae* flower in a peculiar way. The stem, when adult, commences to produce flower-buds through the leaf-sheaths from the top downwards, often alternately male and female, till the last bud close to the ground appears, when the whole stem dies. In the case of *Arenga saccharifera* and *A. Listeri* only one stem is produced, so that the whole plant dies after it has finished flowering. The same thing occurs in all species of *Caryota* except *C. mitis*, which produces five stems or more, but when all have done flowering the whole plant dies. In this species the stems are not produced all at once, but one after the other. I have never seen any of these plants producing axillary buds except from the extreme base.

Palms which start throwing out axillary buds on the erect stems seem to have a tendency to continue throwing out buds from the adventitious stem, as may be seen in *Cocos nucifera* and in *Chrysalidocarpus*. In many cases observed the axillary buds are never well developed, and perish soon.

Plectocomia constantly throws out buds, sometimes from each of the lower nodes, but they rarely, if ever, grow more than a few inches.

In some cases the plants which produce these lateral buds are weak and more or less diseased or injured by insects, but this is by no means always the case. However, I do not remember ever to have come across any branched palms in a wild state except *Plectocomia* and some other rattans.

The following is a list of all the branching palms known to me, including those in Morris's list:—

Areca Catechu.
Rhopalostylis sapida.
Dictyosperma album.
Oncosperma filamentosa.
Dypsis pinnatifrons.
Oreodoxa regia.
Leopoldinia pulchra.
Chrysalidocarpus lutescens.
Phoenix, most species.
Nannorrhops Ritchieana.
Hyphaene thebaica, *H. coriacea*, *H. Petersiana*, normally branched.
Borassus flabelliformis.
Cocos nucifera. The commonest recorded.
Livistona humilis.
Calamus leptospadix.
Plectocomia Griffithii.

Of these it may be noticed that the greater number were cultivated or planted away from their original home, viz. *Areca*, *Dictyosperma* (in one case at least), *Phoenix dactylifera*, *Cocos*, *Chrysalidocarpus*, *Oncosperma filamentosa*, *Dypsis*, *Borassus* (in most instances), and *Calamus leptospadix*; and the best shoot-bearing *Plectocomia* I have seen in an abnormal position in open ground in the Botanic Gardens. While of the others, *Nannorrhops*, *Rhopalostylis*, *Hyphaene*, *Borassus*, *Livistona humilis* occur on the furthest limits of the palm regions, where palms are very scanty, and where the climate appears generally to be dry and the soil rocky or sandy, viz. Afghanistan, New Zealand, Africa, and North Australia.

Areca Catechu (Pl. XXXIV). Among the curiosities brought to the recent Agri-Horticultural Exhibition in Singapore was a very remarkable specimen of a betel-nut palm (*Areca Catechu*) from Pulau Kukub in Johore, sent by the late Mohammed Alsagoff. The tree had been cut down, and shows a lower portion about 3 feet long and 6 inches in diameter, of nine internodes, of which the upper one is somewhat dilated and flattened. Above this is a broad mass of roots, 16 inches wide and about a foot long, from which spring five almost parallel erect branches, 24 feet long to the leaves. All the branches are approximately equal in size, and bear well-developed leaves and inflorescences. At 15 feet from the mass of roots one of them emits a lateral branch, about 6 feet long, bearing leaves. The branching of the betel-nut palm is, I believe, very rare; I have only seen one other instance, that of a specimen shown at a Penang exhibition many

years ago, which bifurcated rather high up, and produced two strong equal stems. This specimen was sent to the British Museum.

In the Johore specimen it appears from the slight flattening of the stem below the mass of roots that this branching is due to fasciation and not to simple axillary buds, as is commonly seen in coco-nut palms, where the branches are often at least distinctly alternate or in simple pairs. Morris, in his paper on branched and forked palms, mentions a few instances of branched betel-nuts, one dichotomously branched at Trevandrum (South India) and one simply branched with two stems at Cayenne. One in Tangire described by Mr. Sinclair more resembles the Johore specimen. It had been attacked by a disease called Band, which had killed many trees in the vicinity, and its top nearly died away, and was replaced by fifteen to eighteen tops growing in a flat close bundle, so that they could not be counted separately without climbing the tree.

Chrysalidocarpus lutescens (Pl. XXXV) is a Madagascar palm often cultivated here. It forms large tufts branching from the roots and attaining a height of 12 feet or more. In one clump in the Botanic Gardens in 1894 I found a number of branching stems. Axillary buds were produced at various heights from the ground. They were emitted at the nodes, and usually slender here, at first more or less horizontal, then ascending and dilating so as often, in early stages, to be fusiform in outline. One emitted roots from its lower nodes, which did not reach the ground. There were often two of these branches on the stem, and not rarely they again branched. The terminal bud of the main stem was uninjured, and the branches were often much below it, and much shorter. Most of these branches died away after a time, but one or two still remain on the clump (1906), and have grown to be almost equal to the main stem in height, so that the stem appears to have bifurcated. The clump which produced most of these shoots is somewhat weakly, compared with others in the garden, and I have noticed the same tendency to throw out side-shoots from the axils in ill-nourished plants of *Dypsis madagascariensis*. The sketches in Plate XXXV are all from the same clump of the palm.

Cocos nucifera. There are many more instances recorded of branching in coco-nut palms than in any other species of palms. This is doubtless due in great measure to the large number of plants in cultivation and to their being very conspicuous and noticeable when branched. Still, in proportion to the number of trees in cultivation, the percentage of branched trees is not large. 'The characteristic feature in branched coco-nuts is the simple fork,' says Morris, and he goes on to suggest that the cause may be due to development of a lateral bud, as in *Hyphaene*, or be consequent upon injury to the terminal bud; 'in the latter case the terminal bud

is destroyed by insects or through some mechanical injury.' 'Two axillary buds inserted immediately below would grow into branches.' This latter suggestion is, I think, an extremely doubtful one. Of the hundreds of trees I have seen attacked by coco-nut beetles so that the terminal buds were destroyed, I have never seen one in which any lateral buds were extruded. Furthermore, when a coco-nut commences to branch, its branches usually continue to branch again, nor indeed does it show any signs of injury by insects or in any other way. In Perseverance Estate in Singapore there was formerly a very remarkable coco-nut tree (Pl. XXXVI), which branched in a somewhat abnormal manner. From a main single stem were emitted three branches. The central one, probably the original main bud, branched again, and both branches died. The other two grew tall, and each branched in a bifurcating manner. One branch died, the other went on growing and branched again. Again one branch died and the other continued to develop, and this happened alternately, every alternate branch dying. In fact, the growth is in this case cymose.

This tree, I was told, had never fruited, and showed no signs of having been attacked by insects or otherwise injured. In all cases of simply forked palms I have seen, the forking is caused by the development of an axillary bud well below the main terminal bud, which it usually catches up in growth some years later, and being then equal in size or nearly so, and parallel to it, suggests that the top has at some time branched, either by dichotomy of the bud, or by two equal buds starting just below the main bud and squeezing it out; I do not, however, see any evidence for either of these theories, and in palms of which I have been able to observe the origin and growth of the two branches neither of these things has occurred.

A bulbilliferous coco-nut (Pl. XXXVII, XXXVIII). For an account, photograph, sketches, and bulbil I am indebted to Mr. R. Scott, who found the tree at Lumut, in the Dindings. The tree, he says, is reported to be ten years old (in 1903), and grows in a Chinaman's coco-nut plantation at Pundut, about five miles from Lumut. It resembles an ordinary coco-nut, except that the foliage is thicker, and has never borne fruit. About five years previously, when it should have started bearing, it put out deflexed shoots instead of flower spathes. These shoots grow for 4 or 5 feet long, the leaves being 2 inches through; when they are as big as this the whole shoot seems to get too heavy, and drops off, and fresh ones appear. The whole appearance of the shoot is like an ordinary young coco-nut, and the centre is formed of a jointed stem about 30 inches long. Bulbils of this nature are not rare in other Monocotyledons, and one might compare them to those of *Globba*, but I do not know of a similar case in a palm. Morris, in describing the branching of *Nannorrhops*, considers that the shoots are replacing the inflorescences, and alludes to a similar occur-

rence in *Phoenix sylvestris*, and perhaps in the Lumut coco-nut we have a parallel case.

Plectocomia is an enormous rattan which, like others of the climbing Calameae, throws up from its base a number of shoots. Of these some, if not all, develop into extremely long branches, which with the aid of their flagella, armed with hooks, climb to a great height on forest trees. These branches in *Plectocomia* are comparatively slender at the base and thicken upwards. In the lower part of the branch, which often lies on the ground, roots are emitted from the nodes, and are practically aerial roots, for, except at the extreme base, they never reach the ground, but run along the branch downwards. It is by no means uncommon to find also shoots emitted from the nodes, and one plant in the Botanic Gardens has produced a shoot from every node near the base. These shoots never develop into branches, but remain quite small, and usually perish with the long climbing branch, which dies completely after flowering.

Calamus leptospadix, a slender rattan from India, grown in the Botanic Gardens at Singapore, not rarely produces (especially when the long climbing stem touches the ground) shoots at the nodes, by which the plant can be propagated.

This layering of a rattan branch is not very uncommon in the jungles, especially where the rattan has fallen across a wild beast track, and elephants, rhinoceros, and such large animals in walking along the track constantly step on the prostrate rattan. The rattan emits roots from its nodes, and then develops a tuft of shoots, which may in time become transformed into a fresh bush.

From these Calami can be obtained the so-called 'reversed rattans,' in which the leaf-sheaths apparently point towards instead of away from the dilated root-bearing portion—very puzzling to explain till it is realized that the thickened head of the cane is not the real base of the rattan, but the thickened portion, which has been layered at some distance from the original root of the plant.

Calamus sp., (Pl. XXXIX). This elegant little dwarf rattan is abundant on Matang mountain in Sarawak. Its stem is a few feet long only, and it hardly climbs. The inflorescence is very lax, and 4 or 5 feet long, with much branched panicles of slender branchlets in the male and fewer and often simple branchlets in the female plant. The inflorescences hanging down usually rest on or close to the ground of the banks in which it grows, and where they do so bulbils are produced from the axils of the sheathing bracts in place of a branch of the inflorescence or quite replacing it. These bulbils take root and develop into fresh plants. This seems to be commoner in the female inflorescence, which is shorter than the male, and generally the bulbils are produced towards the end of the inflorescence. This is not a casual abnormality, but seems to be regular; most female

plants I have seen at least doing so. The plant fruits also, but I have not come across any fully ripe fruit. Judging, however, from the appearance of the plants, especially on the top of Matang hill, this method of reproduction is the commonest. I am quite unable to identify this plant with any of Beccari's descriptions, which in many cases are quite insufficient for purposes of identification, but as it is improbable that he overlooked during his stay on Matang so abundant a plant as this, it is probably one of his species.

EXPLANATION OF PLATES XXXIV–XXXIX.

Illustrating Mr. Ridley's paper on Branching in Palms.

Pl. XXXIV. *Areca Catechu.*

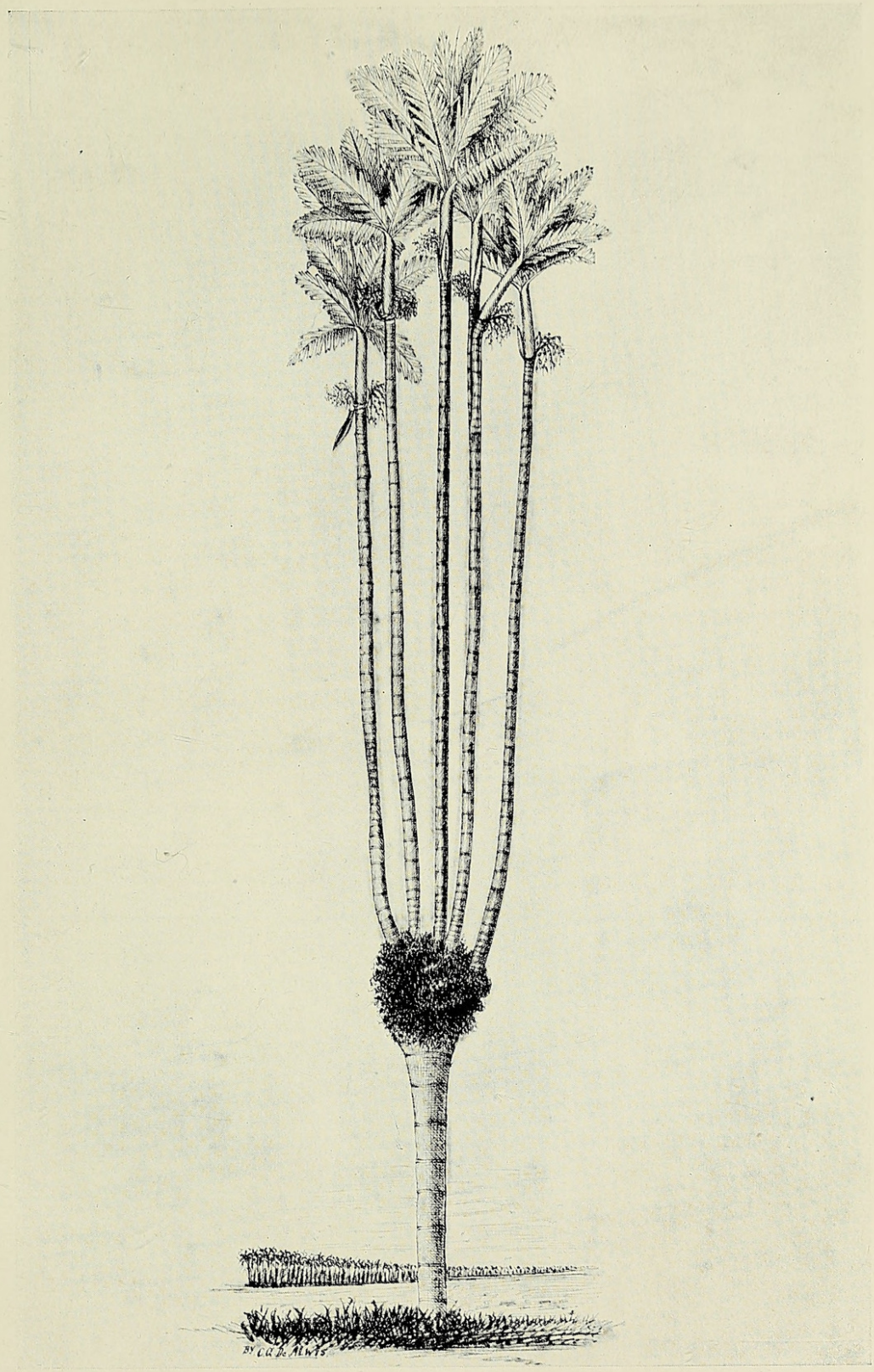
Pl. XXXV. *Chrysalidocarpus lutescens.* *A*, *B*, *D* drawn in 1894; *C* in 1906. *E* is *D* as it now appears in 1906. All from the same clump.

Pl. XXXVI. Coco-nut, branching, from Perseverance Estate, Singapore.

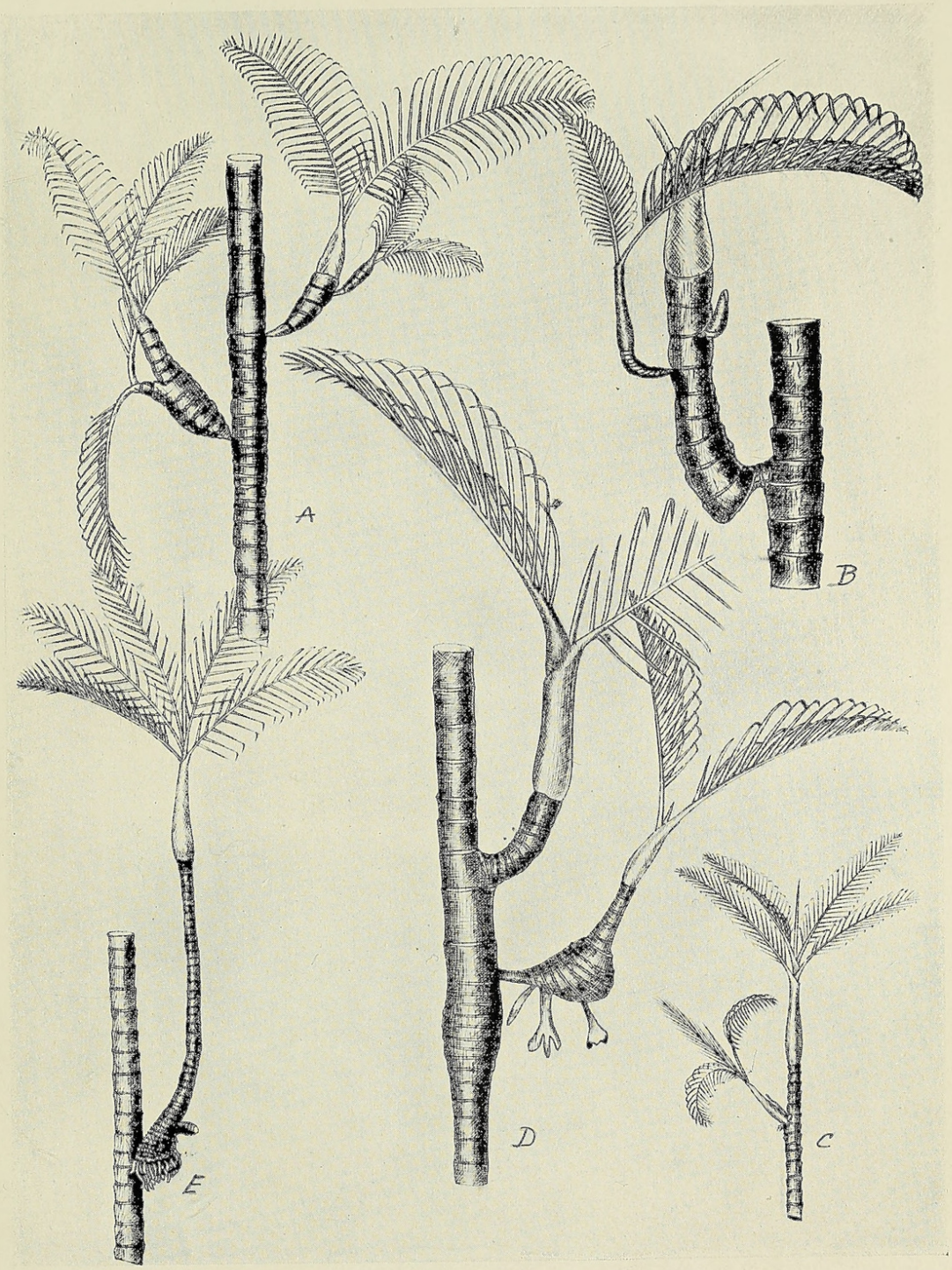
Pl. XXXVII. Bulbilliferous coco-nut. Complete tree.

Pl. XXXVIII. A bulbil.

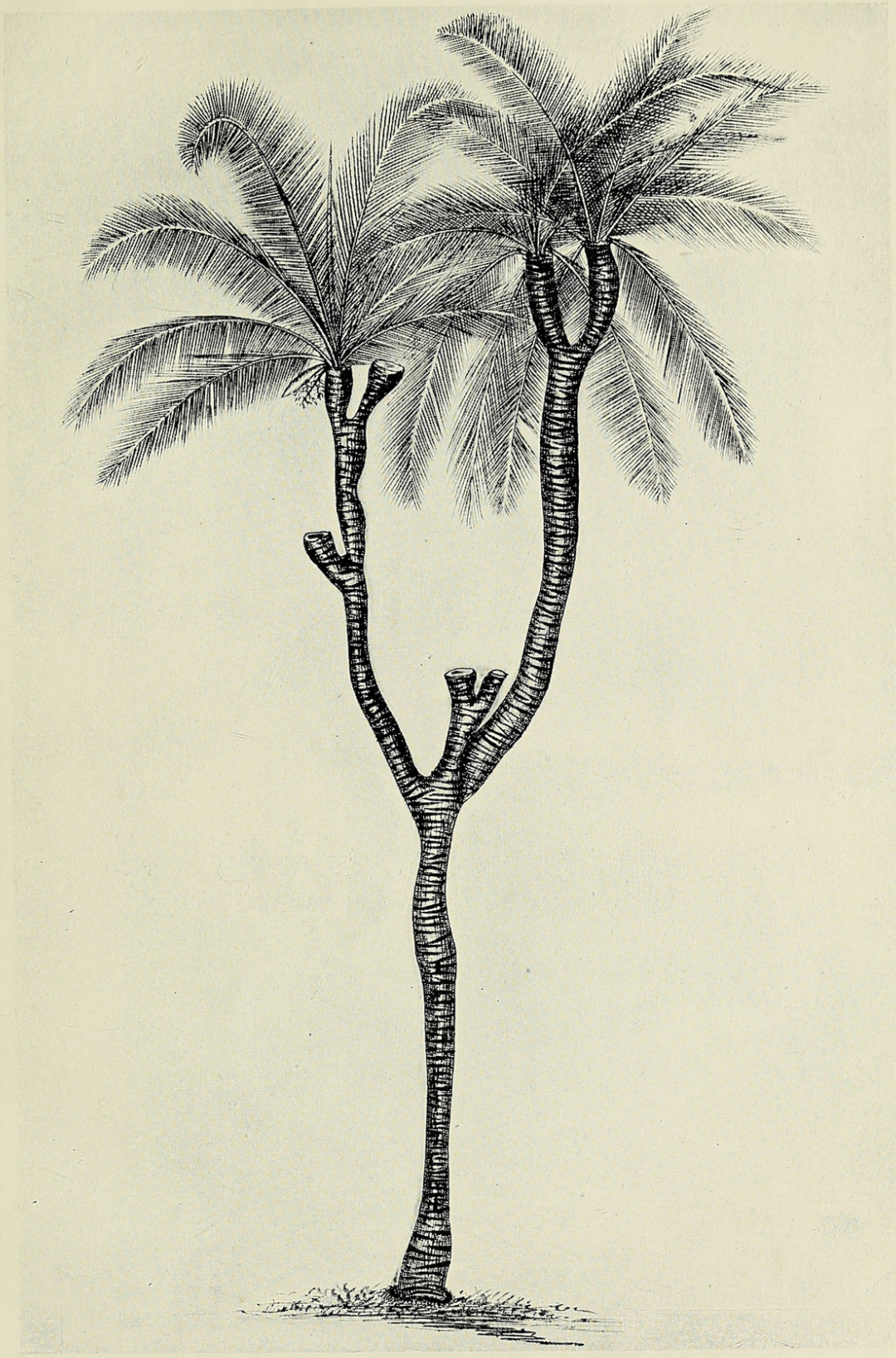
Pl. XXXIX. *Calamus sp.* Sarawak. Portion of inflorescence with bulbils.



RIDLEY—BRANCHING OF PALMS.



RIDLEY—BRANCHING OF PALMS.



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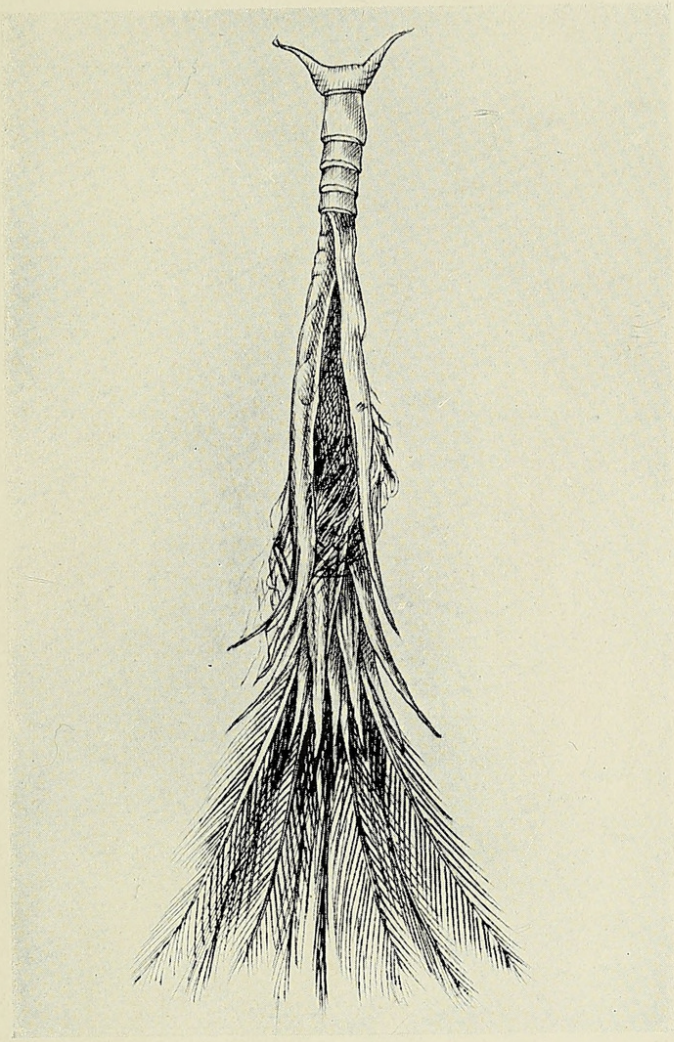

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