tions are frequent. Dyes injected via a bore hole spread rapidly above the level of injection. The path of the dye is not a narrow helical band as it would be if there were no cross-connections. Ciné analysis has demonstrated cross-connections and also hitherto unsuspected complexities in the leaf trace (Fig. 69). Beyond the fork which splits off the leaf trace from the vertical bundle, the leaf trace itself gives rise to a number of additional strands, many from major bundles, few from minor bundles. Of the first of these, 1-3 form short "bridge bundles" which link with neighboring vertical bundles. They are the cross-connections suggested by the dye experiments. There are also several (up to 10) narrow branches which we call "satellite bundles" because they cluster around the leaf trace. These satellites do not enter the leaf but pass into the inflorescence. This inflorescence is only developed fully in the upper parts of the stem, but surprisingly in the lower parts, even though there is no external evidence of an inflorescence, satellites are still developed as an anatomical precursor.

From this kind of three-dimensional analysis we now understand the *Rhapis* stem in great detail. We only have to look through the microscope at single sections of other palms, large and small, to see the same sort of features visible in the photographs Figs. 70-72. We can see similar "leaf trace complexes" but are not always sure about the difference between bridges and satellites. These have to be followed in serial sections to be identified with certainty. Nevertheless we are reasonably sure that *Rhapis* is an accurate, small-scale model of all palm stems. Future work with the ciné camera should establish this beyond all doubt.

Literature Cited

Tomlinson, P. B. 1961. Essays on the morphology of palms VI. The palm stem. *Principes* 5: 117-124.

Zimmermann, M. H. 1961. Movement of organic substance in trees. *Science.* 133: 73-79.

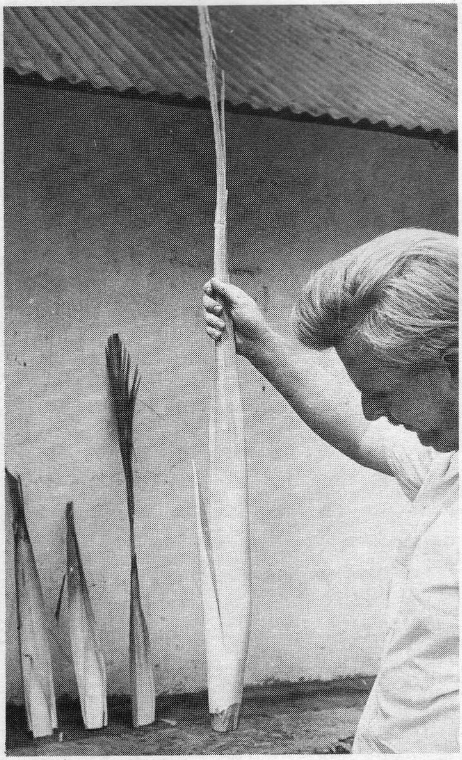
————. 1963. How sap moves in trees. *Scientific American* 208: 133-142.

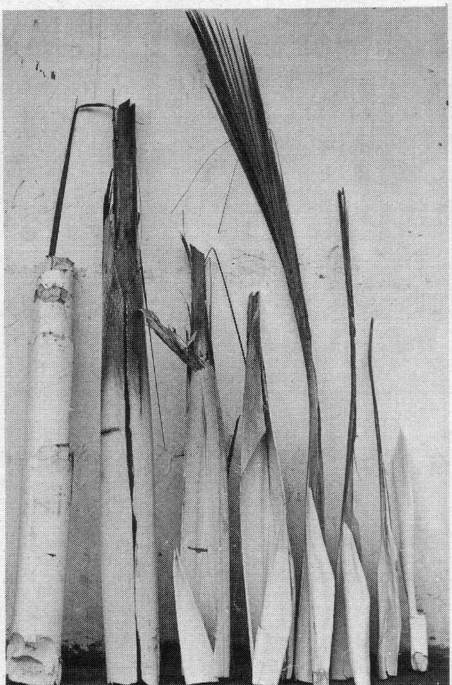
———— and P. B. Tomlinson. 1965. Anatomy of the palm *Rhapis excelsa.* I. Mature vegetative axis. *Journal of the Arnold Arboretum* 46: 160-177.

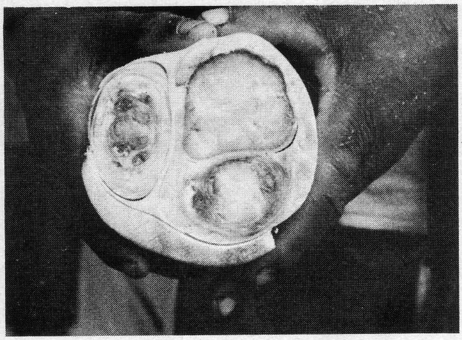
The Inflorescence of Nigerian Lepidocaryoid Palms

P. Tuley

The inflorescence of the *Raphia* palm has been described as a terminal raceme with several branches (Tomlinson, 1962; Russell, 1965). In the course of an investigation into the production of *Raphia* wine (Tuley, 1965), the emergence and size of the terminal leaves was found to be of importance when assessing the readiness of the palms for tapping. The number of reduced leaves is always equal to the number of emerging spadices and as there appeared to be a clear relationship between the two, a mature specimen of *R. Hookeri* was felled and the stem apex dissected. On dissection, the inflorescence primordia were found to be separate structures, arising in the axils of the reduced terminal leaves (Figs. 73-76). The development of a typical group of spadices from just







73. (upper left) The top of the stem of *Raphia Hookeri* with larger leaves pruned away.

74. (upper right), The penultimate leaf with the inflorescence primordium in the axil.

75. (lower left) Complete dissection of stem apex of *Raphia Hookeri*. From left to right: the stem; base of last infertile leaf; five fertile leaves each with its inflorescence primordium, the last primordium at extreme right.

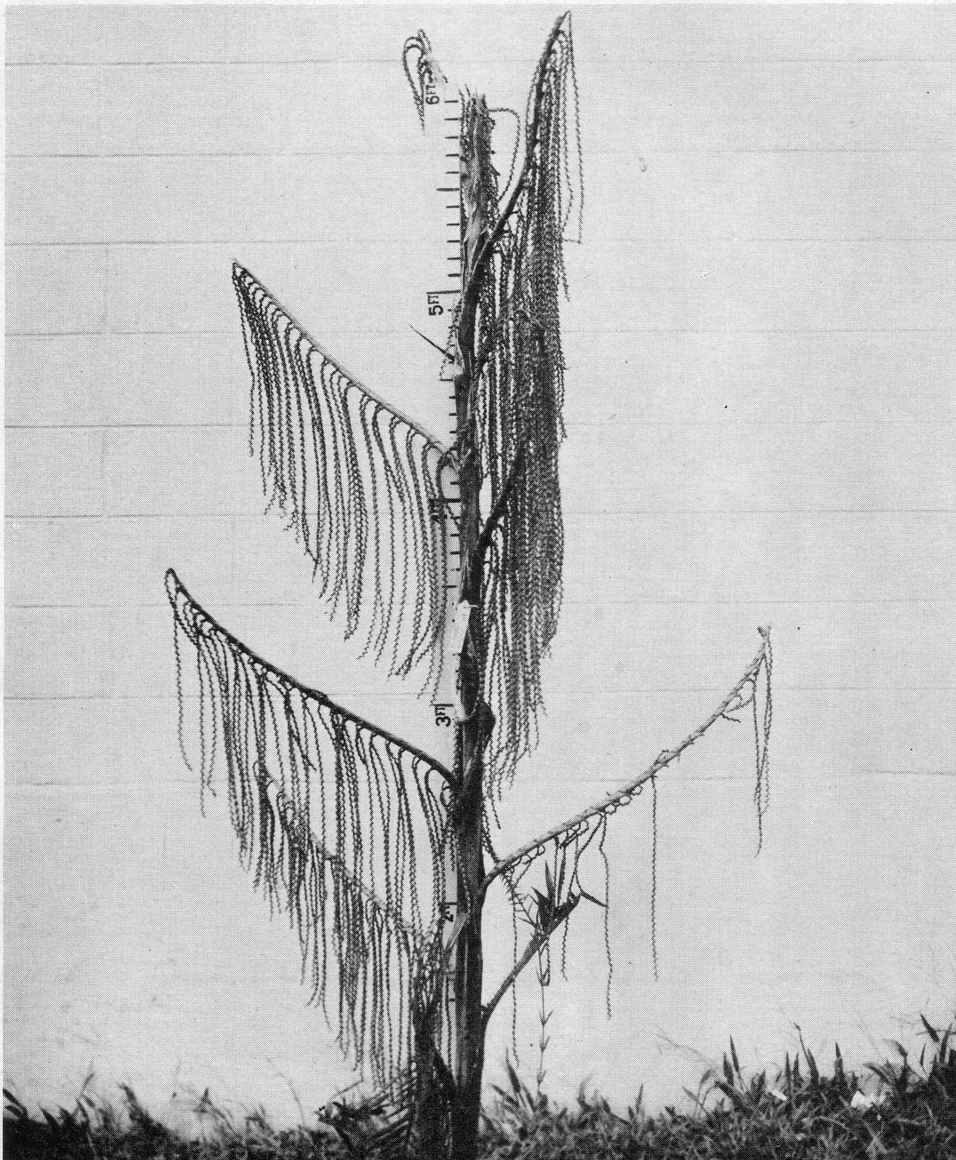
76. (lower right) A cross-section through the stem apex of *Raphia Hookeri* showing two inflorescence primordia and (upper right) the stem.

77. (left) and 78 (right). Development of spadices of *Raphia Hookeri* at weekly intervals from just after emergence (left).

79 (left) and 80 (right). Further weekly stages in development of *R. Hookeri.*

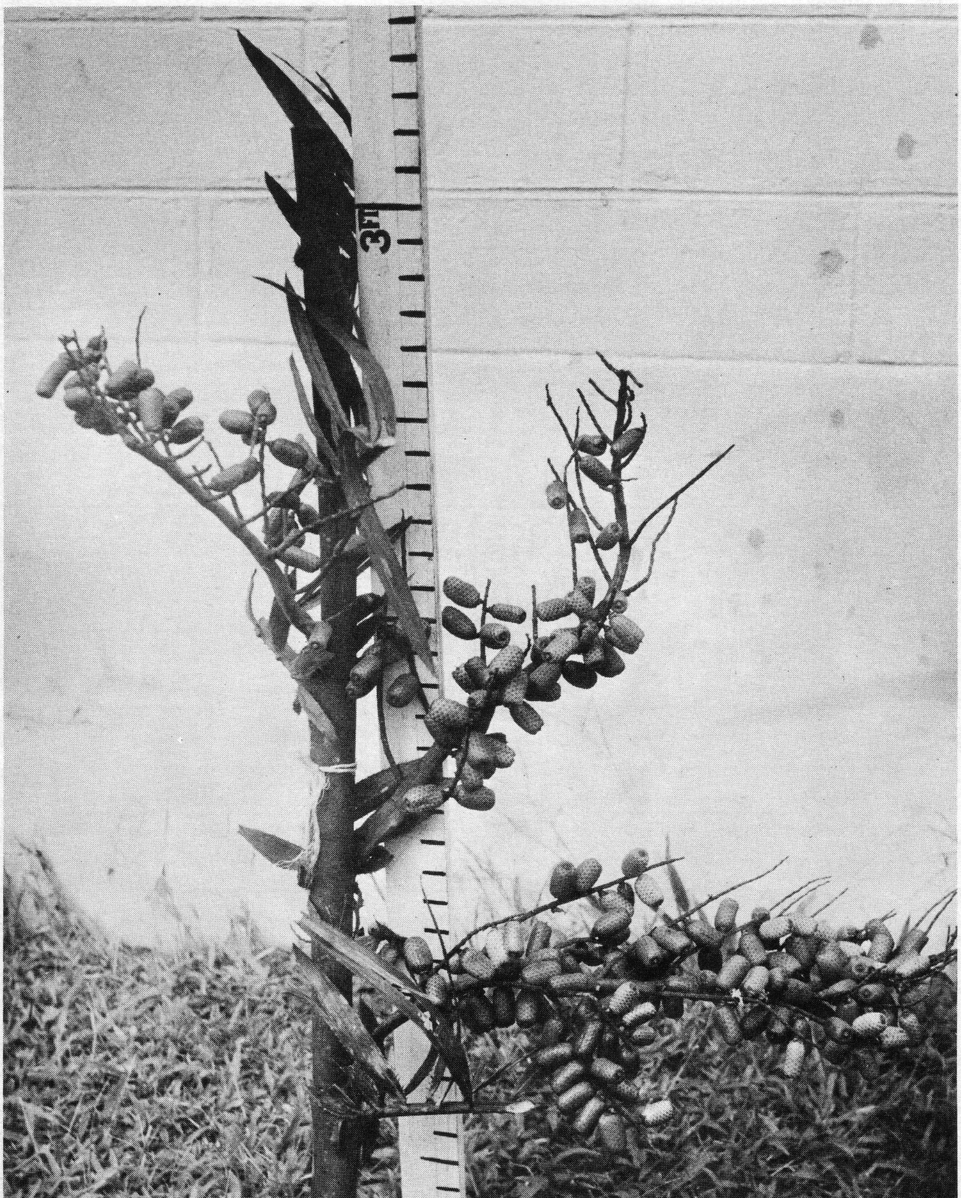
after emergence to the early flowering stage is shown in Figs. 77-81.

In Nigeria, *Ancistrophyllum* is the only other monocarpic genus in this group. Here also a reduction in leaf size is associated with the development



81. A "terminal" inflorescence of *Ancistrophyllum secundiflorum* in flower.

of the inflorescence and the stem can be traced for the full length of the struc-



82. An "axillary" inflorescence of *Eremospatha macrocarpa* in fruit. The stem has been cut at the top and continued for another 10 feet or more when collected.

ture, up to the base of the last branch. The so-called "terminal" inflorescence of *Ancistrophyllum* can be interpreted as a group of axillary spadices arising in the axils of much reduced leaves, represented by the sheathing bases only in the upper parts. It is therefore similar to the so-called "axillary" inflorescences of the other climbing palms (Figs. 82, 83).

All Nigerian members of this group have their spadices, branches and flowers arranged in four rows (sometimes obscured in the more compressed inflorescences but nevertheless recognizable), corresponding to the standard phyllotaxy.

Raphia regalis has only been recorded once in Nigeria and it is described as having a single erect inflorescence with arching side branches. It would be of the greatest interest to study this structure to see if it is truly terminal, an axillary form reduced to a single spadix or possibly an *Ancistrophyllum* - like type.

Literature Cited

Russell, T. A. 1965. The *Raphia* palms of West Africa. Kew Bulletin 19: 173-196.

Tomlinson, P. B. 1962. Palms of Africa. Principes 6: 96-103.

Tuley, P. J. 1965. The production of *Raphia* wine in Nigeria. Experimental Agriculture 1: 141-144.

Branching Palms

W. H. Hodge

The generalized picture that most of us have of a typical palm is of a tree with a single unbranched trunk topped by a crown or "head" or radiating leaves. These are produced regularly and successively during the growing season by the activity of the large terminal bud, located at the apex of the trunk. Even cluster palms, with their numerous unbranched single stems, follow this general picture. Species whose aerial stems branch are so rare as to be classed as oddities of the palm world. The best known branching species is the African doum or gingerbread palm *(Hyphaene thebaica)*. In this plant the stems, for some innate reason, branch regularly and dichotomously to form striking candelabra-like trees which make bizarre silhouettes in the landscapes of the Sudan, Ethiopia and adjacent countries in northern Africa. Each doum palm dichotomy has a double head but the trees sport more than one single dichotomy. The doum palm, known to the ancient civilizations of Egypt, is grown as an unique ornamental in tropical gardens throughout the world, including those of subtropical Florida.

Aerial branching in most other palms is an abnormal condition. Most frequently seen although rare is a single dichotomy giving rise to a so-called double-crowned specimen which is to be considered a freak of nature. These abnormal plants, unlike the doum palm, are presumably caused by some injury to the terminal bud resulting in its division to form two or more separate buds each of which then continues growth on its own giving rise to a double trunk. The injury to the growing point may be due to mechanical damage or the result of activity of insects, disease or the like.

Presumably any single-stemmed palm species, if properly injured could give rise to a double crowned individual. A two-headed royal palm *(Roystonea sp.)* in Haiti was illustrated in an early issue