1. Bentham, G. and Hooker, J. D. *Genera Plantarum*. London, 1862.
2. Stant, M. Y., *Kew. Bull.* 1952, 273.
3. Airy Shaw, H. K., *Kew Bull.*, 1952, 271.
4. Runemark, H., *Bot. Notiser*, 1968, **121**, 29.
5. Das, V. S. R. and Rao, K. N., *Naturwissenschaften* 1966, **53**, 439.

A PRIMITIVE FLOWER IN THE PALM *LICUALA SPINOSA* THUNB.

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LICUALA spinosa Thunb. belongs to the Livistona alliance of the Coryphoideae, which is generally considered as the most primitive group of palms[1]. During a study of the floral anatomy of palms, an interesting gynoecial condition that has so far not been reported in any palm has been found in this species, which is reported here.

The materials were collected from the Indian Botanic Gardens, Calcutta and fixed in FAA. Customary methods of microtechnique and clearing were followed for taking serial transverse sections.

Floral Anatomy

About 10 vascular bundles arranged in the form of a broken ring enter the base of the flower, which unite to form a continuous ring at a slightly higher level. About 15 vascular traces get separated from the periphery of this ring, and supply the outer perianth (figure 1). Each outer tepel is supplied with a dorsal bundle, 2 ventrals and 2 secondary marginals, which divide once or twice at higher levels (figures 2-8). At a higher level, the central ring gives off 9 vascular bundles, a dorsal and 2 ventrals for each of the 3 inner tepels (figure 2). Of these, the ventrals divide once or twice forming secondary marginals. Each dorsal also divides once to separate towards the inner side the vascular supply of the inner stamen, which is adnate with it. The remaining central ring breaks up into 3 large vascular bundles and 9 smaller traces arranged in 3 groups of 3 bundles each. The larger bundles supply the stamens of outer whorl (figures 2-11). The 3 groups of smaller traces divide producing about 10 bundles in each group which form the carpellary supply. At this level the dorsal sides of all carpels are free except at the central region where they are united by their margins with 3 small, roughly triangular structures alternating with the 3 fertile carpels (figures

5 & 6). From each set of carpellary vasculature a single trace moves towards the centre (figure 5). Of the 9 remaining bundles of each carpellary supply (figure 6), one is the dorsal, 2 are ventrals, the other 3 pairs being secondary marginals. The ventrals and secondary marginals disappear in the stylar region. Only the dorsals enter the style (figures 7-9). The carpels are united at the stylar and stigmatic regions. The stylar canal opens to the surface of the stigma which is 3-fid (figures 10 and 11). The ovular supply is produced by the divisions of the ventrals, each ovule receiving 2 traces. The small triangular structures in the centre, which are fused with the margins of the 3 fertile carpels are vestigeal structures representing an inner ring of 3 aborted carpels. The 3 vascular traces going towards the centre (figure 5) are the compound carpellary bundles of the 3 aborted carpels. At a slightly higher level, the 3 central carpels get separated from the margins of the fertile carpels and fuse forming a column. The 3 compound vascular bundles entering this column traverse upwards for a short distance only, so that the upper part of the column is devoid of any vasculature (figure 7).
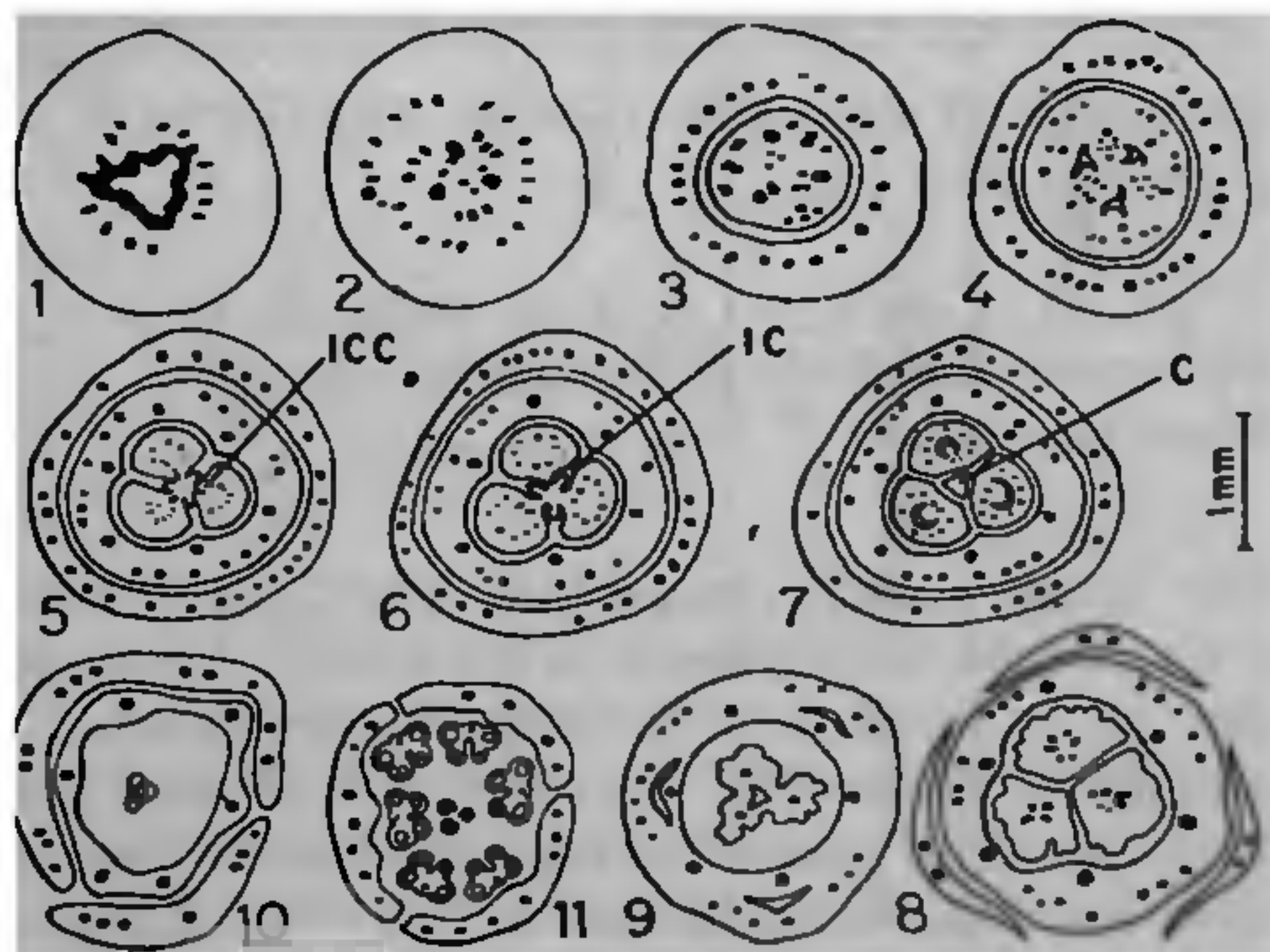
Figures 1-11. *Licuala spinosa.* Serial transections of a flower from below upwards. (C = column formed by the fusion of 3 inner carpels; IC = inner carpel; ICC = compound carpellary bundle of inner carpel).

Licuala spinosa shows all the typical characters of a Coryphoid palm. It is pleonanthic with interfoliar inflorescence. Flowers are bisexual. Perianth is biseriate with 6 tepels arranged in 2 whorls. Stamens are also 6 in number, originating in 2 whorls of 3 each. The formation of a completely coalescent ring of bundles at the base of the flower reflects a shortening of the floral axis, which is in conformity with this trend. The carpels here are free at their bases but are united at their stylar and stigmatic regions. A similar type of cohesion of carpels is found in *Nannorrhops* of Cory-

pha alliance also of Coryphoideae, suggesting a close relationship between Corypha and Livistona alliances[2]. The vasculatures of the tepels, stamens and fertile carpels are typical of Coryphoid palms[23].

In Palmae the gynoecium usually consists of 3 carpels arranged in a single whorl. A few palms, as *Thrinax*, are unicarpellary. In some abnormal forms 2 or 4 carpels may also be developed. However, the presence of a second whorl of 3 carpels in addition to the normal whorl of 3 carpels as a regular feature in the gynoecium of a palm has not been detected so far. The presence of a second whorl of 3, vascularized, vestigeal carpels as a normal condition in *Licuala spinosa* represents the most primitive gynoecium in palms. Such a structure in this species is indicative of the origin of Coryphoid palms from an ancestral stock with atleast 2 whorls of 3 carpels each.

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1. Moore, H. E.,*Gentes Herb.*, 1973, 11, 27.
2. Uhl, N. W. J.,*Arnold Arb.*, 1969, 50, 411.
3. Uhl, N. W.,*Principes*, 1972, 16, 89.

EMBRYOGENESIS IN THREE SPECIES OF *VANDELLIA* L.

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THE study of embryogenesis in Gratioleae of Scrophulariaceae is restricted to a few taxa[1-3]. Three species of *Vandellia* L. (*V. molluginoides* Benth., *V. sessiliflora* Benth. and *V. pedunculata* Benth.) have been chosen for study of embryogeny and the observations are detailed in this report.

Fruiting ovaries in different stages of development of the aforesaid species were collected and fixed on the spot in Carnoy's fluid. Customary methods were followed during dehydration an embedding. Sections were cut between $8-12\,\mu$m and stained in crystal violet and erythrosin combination.

The zygote elongates appreciably (figures A, B), becomes tubular and remains quiscent of considerable period amidst developing endosperm which is *ab initio* Cellular. The first division of the zygote (transverse) occurs after the initial genesis of the endosperm is completed, resulting in a smaller apical cell *ca* and an elongated basal cell *cb* (figures C, D). The former divides vertically and the latter transversely forming two cells *m* and *ci* (figures E, F); consequently a T-shaped proembryonal tetrad corresponding to A₂ category of Soueges[6] is organised (figure F). However,

in *V. sessiliflora* the basal cell *cb* of the two-celled proembryo divides earlier than *ca* (figure G). Soon the two juxtaposed cells derived from *ca* initiate the quadrants, *q* after one more vertical division occurring in a plane perpendicular to the earlier one (figures H, I). Transverse division of the quadrants results in the octants disposed in two superposed tiers of four cells each; the upper tier designated as *l* and lower as *l'* (figures J, K). As the aforesaid developmental changes occur in *ca*, the middle cell *m* of the proembryonal tetrad as well its lowermost cell *ci* segment transversely engendering respectively cells *d, f, n* and *n'* (figures H, J, K). In 4% of the preparations of *V. pedunculata* the cell *n'* divides prior to the organisation of *ca* into octants (figure I). Periclinal divisions occur in the tier *l* and *l'* and delimit dermatogen *de* from an inner group of cells (figure L). Similar division in the inner group of cells of *l'* differentiates the histogens namely the outer periblem *pe* and the inner plerome *pl* (figures M, N). Anticlinal divisions occur in the cells of the dermatogen in the tiers *l* and *l'* (figures M, N). Transverse division occurs in the cell *d* before or after the differentiation of dermatogen in octants (figures K, L, M, N) delimiting an upper daughter cell which functions as the initial cell of the root cortex *iec* and lower cell acts as the initial cell of the root cap *ice*. As a rule these cells engender two plates of four cells each consequence upon two vertical divisions at right angles to one another (figures N, O). Further segmentation in these cells results in the organisation of the root cortex *iec* and the root cap *ico*. In the tier destined to form the cotyledons and shoot apex, both transverse and vertical divisions occur and the embryo eventually passes through the globular (figures N, O, P) and heartshaped (figures Q, R) stages. Further divisions in the inner group of cells of the tier *l* engender the cotyledonary region *pco* and stem apex *pvt* (figures R, S, T, U), while the cells of the tier *l'* contribute to the hypocotyledonary part *phy* and the initials of central cylinder of stem *icc* (figures R, S, T, U). The cells derived from *f, n* and *n'* build up a short suspensor which is four-celled in *V. molluginoides* (figures M, N, O), six to eight-celled in *V. sessiliflora* (figures R, V) and five-celled in *V. pedunculata* (figure S). The uniseriate suspensor ultimately degenerates as the embryo matures (figures U). In *V. pedunculata* a couple of instances have been seen where vertical walls are laid down in some of the suspensor cells (figure W).

The mature embryo in the ripe seed is comparatively massive, straight and well differentiated. It has two cotyledons, shoot apex, a long hypocotyledonary part, a radical and vascular supply to other cotyledons (figure T, U).