# A CONTRIBUTION TO THE LIFE-HISTORY OF *ARTOCARPUS LAKOOCHA* ROXB.

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*Artocarpus lakoocha* belonging to the family Moraceæ is a tree, monœcious in habit. It is tropical in distribution and flowers towards the end of November in Calcutta. It has been reported in India from Assam, Bengal, Behar, Orissa, Madras, Uttar Pradesh and Bombay.

The earlier work on the embryology of the family has been recorded by Schnarf (1931). During recent years a few important papers have been published of which mention may be made of Subba Rao's (1940) work on *Artocarpus integrifolia* and Anantaswamy Rau's (1942) on *Strebulus asper*.

## Material and Methods

The material for this investigation was obtained from a plant growing in the college compound. It was fixed in Nawaschin's and Allen's modified Bouin's fluids. Before fixation the catkins were cut into small bits and the core of the catkins were removed. The materials were dehydrated, cleared and embedded in the usual way. Sections were cut 8 to 12 microns thick and stained in Heidenhain's iron-alum hæmatoxylin.

## Observations

*Floral morphology.*—The catkins are axillary and diœcious. The male catkins appear first. Both the catkins have a club-shaped central core around which the flowers are compactly arranged. A sterile collar is present at the base of the catkins.

The male flower is represented by a single stamen and is surrounded by the perianth which grows rapidly and arches over the stamen (Fig. 1). In the female catkin the growth of the perianth is unequal, it encloses the pistil, the style of which projects out of the flower in the mature stages (Figs. 2 and 3).

2. *The Anther and Pollen Development.*—In the initial stages of development, the anther is bilobed in appearance and consist of a mass of homogeneous cells. The archesporial cells become differentiated in the hypodermal layer and are easily made out by the rich cytoplasmic contents of the

cells (Fig. 4). They soon divide to produce a primary parietal and a sporogenous layer. The parietal layer divides to give rise to the endothecium and an inner layer, which divides by periclinal wall. The innermost layer divides again to produce the tapetal cells on the inside (Fig. 5). The two middle layers get crushed during the development of the microspores. The tapetum is of the secretory type. During the meiotic divisions of the microspore mother cells, the nuclei of the tapetal cells divide giving rise to binucleate tapetal cells. The endothecial cells show the characteristic fibrallar bands only at maturity.

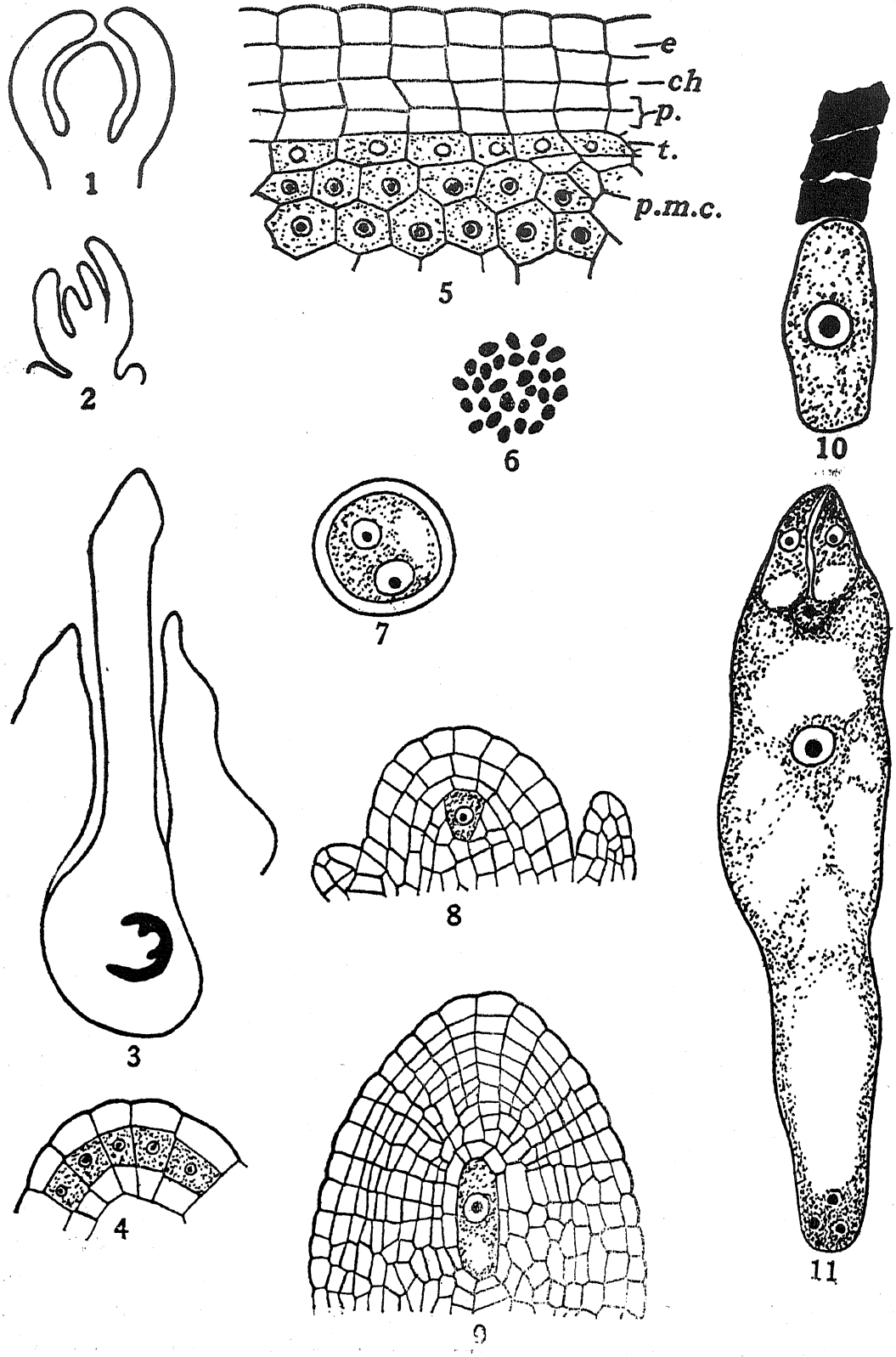
The primary sporogenous cells divide a number of times to give rise to microspore mother cells. Meiosis appears to be normal. At diakinesis the pollen mother cells round off. During metaphase of division I, 28 bivalent chromosomes are seen (Fig. 6) and the same number has been recorded during the II division. At the tetrad stage the microspores become invested by a mucilaginous substance. The microspore tetrads are mostly of the tetrahedral type and cytokinesis takes place by furrowing.

The pollen grains are spherical in outline and measure from 14·2 to 16·4 microns in diameter.

3. *Ovule and megasporogenesis.*—There is a single bitegmic crassinucellate ovule in each ovary. It arises as a lateral protuberance but soon curves and assumes an anatropous form (Fig. 3). The inner integument is the first to arise and consists of 2–3 layers of cells. The outer integument is comparatively massive and consists of 4–6 layers of cells. The inner integument gives rise to the micropyle.

The archesporial cell arises even before the origin of the outer integument in the 4th layer of the nucellus (Fig. 8). It increases in size and directly functions as the megaspore mother cell. During the reduction divisions of the megaspore mother cell, the cells of the nucellus lying above it, divide by anticlinal and periclinal walls and give rise to a nucellar cap many cells in thickness (Fig. 9). The megaspore mother cell divides resulting in two dyad cells which divide once again to produce a linear row of four megaspores. The chalazal megaspore functions while the remaining three degenerate (Fig. 10).

4. *Female Gametophyte.*—The functional megaspore increases very much in size and is seen to be capped by the remnants of the degenerating megaspores (Fig. 10). The nucleus move to the centre and divides to produce the bi-nucleate stage. At this stage the embryo-sac shows distinct polarity and there is a big central vacuole. Subsequent divisions lead to the




FIGS. 1-11

TEXT-FIGS. 1–11. *Artocarpus lakoocha.* Fig. 1. Early stage of development of male flower, ×50. Fig. 2. Early stage of development of the female flower, ×50. Fig. 3. Female flower showing the protruded stigma and the developing ovule, ×75. Fig. 4. Origin of archesporium in the anther. ×650. Fig. 5. L.S. of anther showing the tissues; *e*, epidermal layer; *en*, endothecial layer; *p*, parietal layers; *t*, tapetal layer; *p.m.c.*, pollen mother cells, ×650. Fig. 7. Pollen grain, ×1,800. Fig. 8. Differentiation of the M.M.C. at the fourth layer of the nucellus, ×650. Fig. 9. M.M.C. pushed below the nucellus due to the division of the cover cells, ×600. Fig. 10. Linear tetrad of megaspores. Upper three degenerating, lower functional, ×700. Fig. 11. Mature embryo-sac ×900.

four and eight nucleate stages. The embryo-sac increases gradually in size from the 1-nucleate stage onwards. Comparative size of the embryo-sac at different stages of growth is presented below.

TABLE I

*Size of the Embryo-sac at Different Stages of Development*
*(size in microns)*

| Stage | | Length | Breadth |
|---|---|---|---|
| 1-Nucleate | .. | 48·60 | 12·96 |
| 2-Nucleate | .. | 50·76 | 13·42 |
| 4-Nucleate | .. | 65·88 | 22·68 |
| 8-Nucleate | .. | 90·00 | 24·68 |
| Mature E.S. | .. | 113·40 | 28·23 |

It would be seen from the above table, that growth in length is far more rapid and greater than that in breadth. Besides, the maximum increase in length takes place after the 8-nucleate stage.

The synergids are pear-shaped bodies with centrally placed nuclei and basal vacuoles. The egg is situated centrally and protrudes beyond the synergids. The secondary nucleus lies in the centre of the embryo-sac, connected by cytoplasmic strands. The antipodal cells are ephemeral (Fig. 11).

## CONCLUSION

Darlington and Janaki Ammal (1945) have given a comprehensive list of the chromosome numbers of plants belonging to Moraceæ. In the genus *Artocarpus*, the diploid number has been recorded as 28 for *Artocarpus cannoni* and 56 for *A. integrifolia* and *A. communis*. In the present investigation 28 haploid chromosomes have been observed and thus it clearly indicates that there is a polyploid series in the family.

In *A. integrifolia*, Subba Rao (1940) found the archesporial cell to be hypodermal in origin but the megaspore mother cell was differentiated in the 4th layer of the nucellus, while Anantaswamy Rau (1942) does not mention the origin of the archesporial cell, but states that the megaspore mother cell is noted in the 4th layer of the nucellus in *Strebulus asper*. From these observations, as well as that obtained in the course of the present study, it may be inferred that the megaspore mother cell is not hypodermal in origin, but differentiates deep inside the nucellus.

The present investigation supports the observations of previous workers and conclusively proves that the development of the embryo-sac in the family *Moraceæ* is of the *Polygonum* type. It is interesting to note, however, that in the allied family Ulmaceæ, the *Adoxa* type of embryo-sac development has been recorded in *Ulmus americana*, *U. fulva*, and in a few other species (Maheshwari, 1941).

## SUMMARY

The development of the microspores is of the simultaneous type. The haploid number of chromosomes is 28.

The pollen grains are binucleate at the shedding stage.

The ovules are anatropous and bitegmic. The nucellus is massive.

The archesporial cell arises in the fourth layer of the nucellus and directly functions as the megaspore mother cell.

The development of the embryo-sac is of the *Polygonum* type. The antipodals are ephemeral.

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