abundance of the plastids in the normal pegs and their scantiness in the abnormal ones, it may be inferred that these bodies or the organs of perception that respond to gravity and bring about positive geotropic movement. The plastids appear first after fertilisation. If they are not formed at that time, the peg grows quite erect. In some pegs, the number and the size of the plastids get diminished, or they might disintegrate, after a period of normal growth; and then the peg curves upwards and becomes negatively geotropic. The function of the plastids is not analogous to that of the freely moving starch grains in certain grass roots, where they are said to bring about curvatures due to internal excitement set up by them (Statolith theory of geotropism). Unlike the starch grains, the plastids are confined to the upper part of the lumen of the cell. Their exact nature and the reason why after a period of normal functioning, they become affected and functionless, in certain rare instances, are not known; further study is expected to throw light on this very interesting subject.

The abnormal pegs did not produce any pods and seeds possibly for want of medium of sufficient resistance. In a set of experiments conducted in the Oil Seeds Section, the developing gynophores were made to enter artificially made up media. For this bamboo tubes about six inches long and about an inch in diameter and having a node septum at one end to act as bottom, were filled each with wet and dry, ordinary soil, stiff clay, sterilised sand, powdered wood charcoal, saw dust, cotton wool and also water separately. Empty tubes, dry and moist, were also set up. The tubes were buried in the soil to keep them in position and were covered with circular paraffined straw boards to make the tubes dark inside. Small perforations just to allow the passage of the gynophore were provided. Pods developed uniformly in the soil, clay and powdered charcoal irrespective of the medium being moist or dry; but pods did not form in the other media, *viz.*, saw dust, cotton wool and air, possibly for want of sufficient resistance.

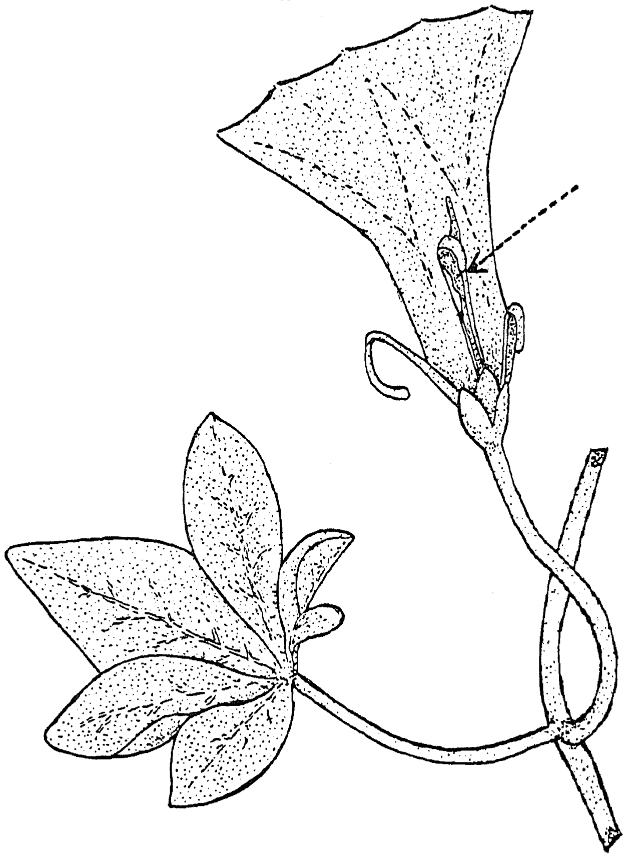
J. S. PATEL.
G. V. NARAYANA.

Oil Seeds Section,
Agricultural Research Institute,
Coimbatore,
June 7, 1935.

Duplicate Corolla in *Ipomœa palmata* Forsk.

Ipomœa palmata Forsk is a common garden convolvulus in Bombay. Ordinarily its flowers have a single infundibuliform corolla.

Recently, a plant of this species has been observed putting forth flowers which bear five additional free petaloid structures about



3 cm. long and 0·5 cm. broad; arising outside and jointly with the base of the corolla. The facing of this new whorl is inside out.

This additional development in a large number of flowers on a single plant is worth registering.

S. C. DIXIT.

Wilson College,
Bombay 7,
July 22, 1935.

Studies in the Development of the Pollen Grain and Embryo Sac of *Wolffia arrhiza*.

THIS interesting plant—the smallest angiosperm known—is seldom seen flowering. In November, 1933, the writer found it flowering abundantly near Agra. A study of the development of the gametophytes revealed several important differences from those of *Lemna minor* (Caldwell, 1899).[1]

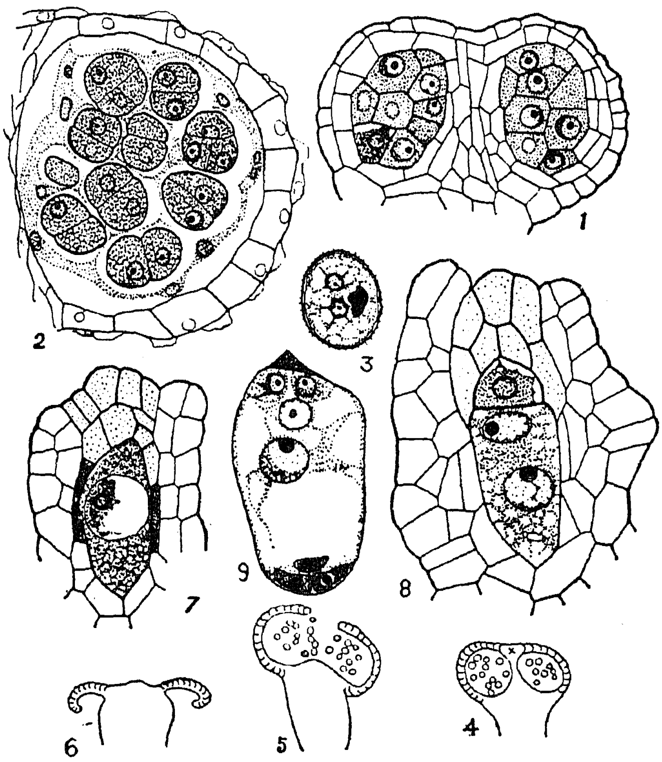
Microsporogenesis and Male gametophyte.—The stamen, in early stages, consists of a very short filament and a spherical anther containing a mass of homogeneous cells covered over by the epidermis. Soon a sterile plate of cells running vertically divides this mass into two so that by the time the peripheral archesporial cells cut off the primary parietal layer, the microspore mother-cells are seen in two distinct groups and the anther becomes bilobed in outline (Fig. 1). The primary parietal layer divides to form the endothecium and the tapetum (Fig. 1) ; there is no middle layer whatever. At maturity the cells of the endothecium enlarge and develop the usual fibrous thickenings while the epidermal cells degenerate and are sloughed off.

The tapetal cells, which remain only one-nucleate, become amœboid and project into the loculus (Fig. 2). The reduction divisions in the microspore mother-cells are successive, but a few cells lying towards the periphery do not undergo any divisions and degenerate.

In the pollen grain the generative nucleus is at first organised into a small lenticular cell separated from the large tube cell by a narrow space. Later, the generative nucleus becomes free though still surrounded by a cytoplasmic sheath. At this stage the periplasmodium is about to disappear completely and so is the sterile partition between the two lobes. The mature pollen grain is three-nucleate and the tube nucleus shows a degenerated appearance (Fig. 3).

The dehiscence of the anther is rather interesting. About the time when the pollen grains are 2-nucleate, the cells of the endothecium lying just over the sterile partition (at x in Fig. 4) presents a degenerated appearance and do not show the usual fibrous thickenings—these cells facilitate the opening of the anther (Fig. 5). At this stage the sterile plate of cells separating the two loculi also disappears and the two halves of the endothecial coverings curve outwards and downwards exposing the entire mass of pollen grains for dissemination (Fig. 6).

Megasporogenesis and Female gametophyte.—The nucellus in the early stages consists of only a few cells—the hypodermal archesporial cell usually surrounded by one layer of cells. This cell cuts off the primary parietal cell which undergoes one or two anticlinal divisions (Fig. 7). The megaspore mother-cell enlarges considerably destroying the whole of the nucellus except the two layers of cells at the top, so that the lateral sides of the subsequently formed embryo sac lie immediately adjacent to the inner integument. The megaspore mother-cell divides into two cells of which the upper degenerates while the lower, after 3 successive divisions of its nucleus, forms the normal eight-nucleate embryo sac (Figs. 8–9). Thus the development of the female gametophyte is of the "*Scilla type*" while in *Lemna*, Caldwell



FIGS. 1-9.

Figs. 1-9, showing the development of male and female gametophytes in *Wolffia arrhiza* Wimm Figs. 1-2 ×375. Figs. 4-6 ×43. Figs. 3, 7, 8, 9 ×630.

(1899) reported this to be of the "*Lilium type*". The antipodals are ephemeral and the polars fuse early (Fig. 9).

The ovule remains orthotropous throughout its development. Of the two integuments, the outer begins to develop only after the megaspore mother-cell has undergone one division. The carpel shows a clear stylar canal extending throughout its length. Further investigation on the development of the endosperm and embryo is in progress.

I am greatly indebted to Dr. P. Maheshwari for his kind help and valuable suggestions.

B. L. GUPTA.

Department of Botany,
Agra College,
Agra, India,
March 29, 1935.

[1] Caldwell, O. W., "On the life-history of *Lemna minor*," *Bot. Gaz.*, 1899, **27**, 37-66.