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FLORAL ORGANOGENESIS OF *ANEMONE VITIFOLIA*[1]

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ABSTRACT

The five tepal primordia arise as semilunar humps in clock or counter clockwise sequence. The numerous stamens are initiated in five groups which extend laterally and vertically. Their arrangement on the receptacle is closer to a whorled condition, clearly not in spiral. The carpel primordia also do not show clear spiral arrangement.

INTRODUCTION

The Ranunculaceae are regarded as one of the most primitive families of living angiosperms. They are considered by many to be very similar to the Alismatales in the general structure of flowers (Hutchinson, 1959). In recent years there have been several detailed studies on the organogenesis of the flowers of the Alismatales (*see* Sattler and Singh, 1978). A study of floral organogenesis in Ranunculaceae has been initiated with a view to assess the extent of similarities between the two groups. This will be done in the last paper in the series. This paper, first of the series, reports floral organogenesis of *Anemone vitifolia*.

MATERIAL AND METHODS

Inflorescences of *Anemone vitifolia* Buch.-Ham. ex DC. in all stages of development were collected from a natural population in Mussoorie. They were fixed in formalin-acetic acid-alcohol and preserved in 70% ethanol. The material was stained in alcoholic acid fuchsin, and then dissected and photographed following the technqiue of Sattler (1968).

OBSERVATIONS

Organography: Showy white flowers of *Anemone vitifolia* are borne in dichasial cymes. They are bracteate, bracteolate, hermaphrodite, actinomorphic and hypogynous. The bracts and bracteoles resemble the foliage leaves. The uniseriate perianth consists of five petaloid tepals. The numerous free stamens appear to be spirally arranged. The filaments are long with basifixed, dithecous and extrorse anthers. The numerous free carpels are crowded on a globose receptacle. Each carpel has a superior and unilocular ovary bearing a single pendulous ovule. The style is short and the stigma simple. The achenes are flattened and pointed.

Organogenesis: A dome-shaped floral apex arises in the axil of each bract. It produces two bracteole primordia laterally which grow fast in the initial stages and partially cover the floral apex even before tepal inception (Fig. 1).

The tepal primordia arise as semilunar humps on the flanks of the floral apex (Figs. 2, 3). The sequence of their inception varies in different buds and may be clock-or counter-clockwise. There is a long plastochron between the incep-

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tion of the first and the fifth tepal primordia as is evident from the difference in their size (Fig. 4). The tepal primordia assume a quincuncial aestivation (Fig. 4).

Following tepal inception, five stamen primordia are formed almost at the same time in the spaces alternating with the tepal primordia low on the flanks of the high dome-shaped floral apex (Fig. 4). They are followed by one stamen primordium on either side and slightly above the first formed stamen primordia. Almost at the same time a stamen primordium is also formed in the antitepalous position between the two first formed stamen primordia (Fig. 5). Alternating with the previously formed primordia, new primordia are initiated at a slightly higher level. Subsequently numerous stamen primordia are initiated alternating with the previously formed primordia in a centrifugal sequence (Figs. 6, 7). As a results of this continued alternation, vertical and horizontal rows of numerous stamen primordia become apparent (Figs. 8, 9.). Irregularities are, however, fairly common. There are 25 to 30 vertical rows while the horizontal rows vary form five to seven. During further growth each stamen primordium differentiates into a basal and a distal portion (Fig. 13). The former gives rise to a somewhat flattened filament and the latter develops into a dithecous extrorse anther.

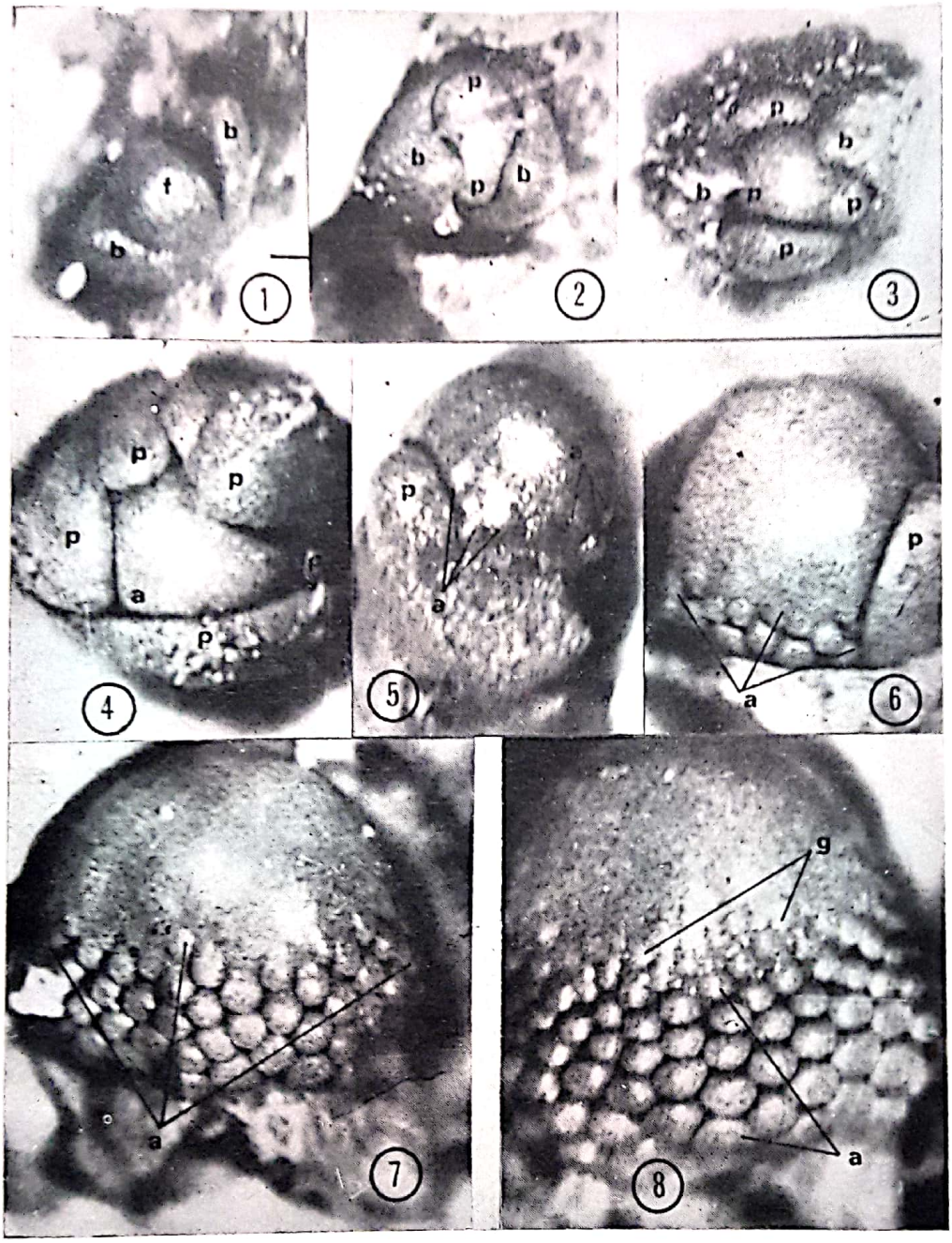
The numerous carpel primordia are formed in alternation and in continuation with the sequence of the stamen primordia. The floral apex continues to expand during carpel inception. The carpel primordia also appear to be arranged in vertical and horizontal rows (Figs. 9-11). The whole floral apex is used in the formation of the carpel primordia (Fig. 11).

A young carpel primordium is more or less hemispherical, very much resembling a stamen primordium (Figs. 8, 9). But as growth and development continues marked differences appear. Shortly after inception, the carpel primordium becomes shomewhat flattened and an area in its centre stops growing or shows very much retarded growth (Fig. 10). The periphery of the primordium, however, continues to grow and as a result of this a central depression is formed. Now two growth centres become distinguishable on the peripheral rim, one on the adaxial side and the other on the abaxial side. As growth proceeds along these two growth centres the central depression assumes the shape of an elongated cleft (Fig. 11, 12). Growth is more rapid on the adaxial side and a hood -like structure thus resulted forms the ovary which narrows into the short style (Fig. 13). The stigma differentiates at the tip of the style.

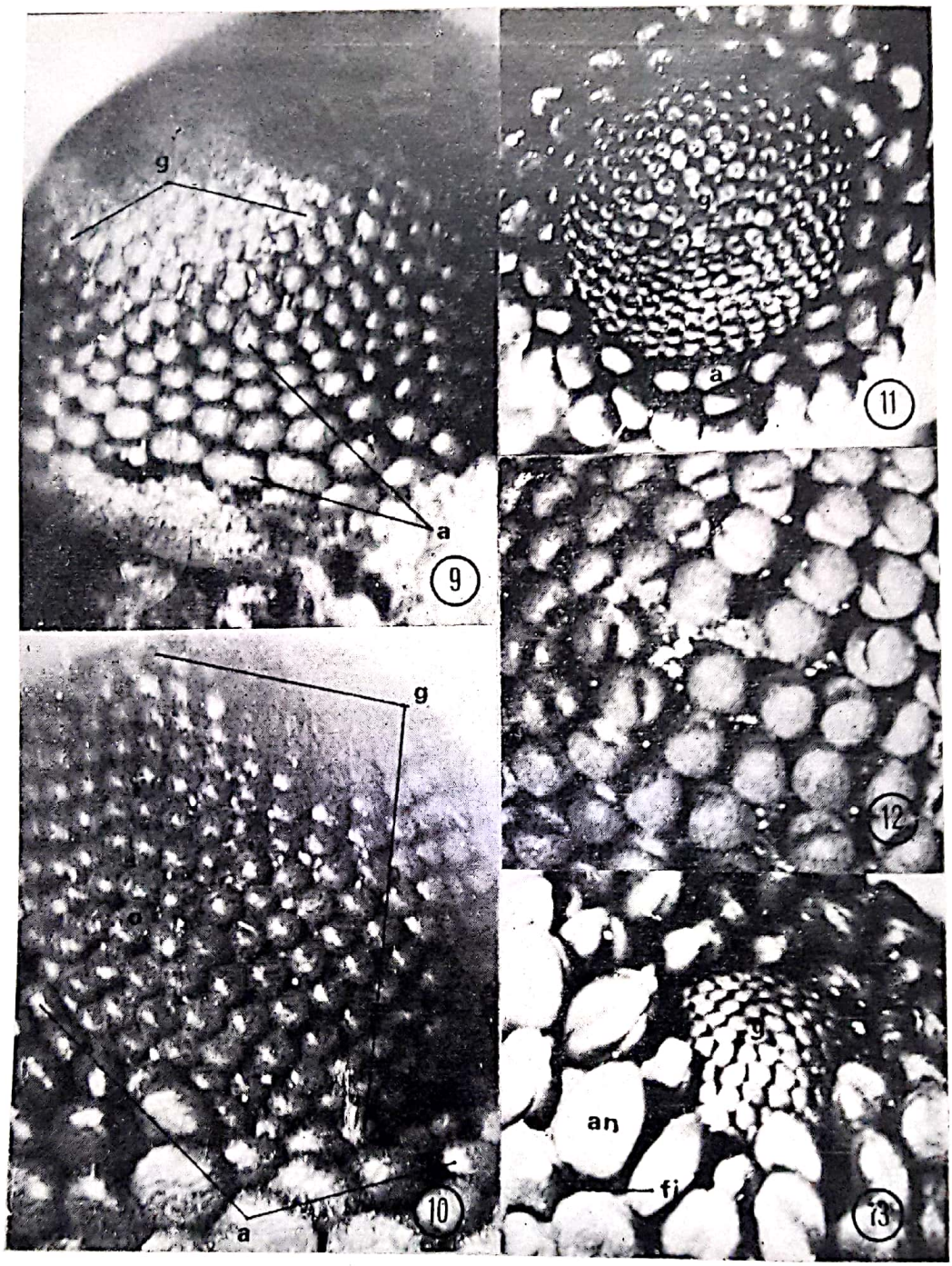
A single ovule primordium is initiated on the adaxial side of the carpel primordium and is enclosed by the growing ovary wall (Fig. 11, 12). As the ovule primordium grows, it develops a single integument.

DISCUSSION

There is a general notion that numerous free stamens and carpels in the flower of Ranunculaceae are spirally arranged on the receptacle. Tepfer (1953), who made a detailed study of the floral development of *Ranunculus repens* also reports that in this taxon the stamens are inserted in spirals and not in whorls. However, Sattler (1973) states that it is not quite true for *Ranunculus acris* where he could not detect any distinct spiral arrangement of the stamens. He observed that the arrangement of stamens is closer to a whorled condition with



Figs. 1-8. *Anemone vitifolia*. 1—A floral bud in top view after the formation of bracteole primordia. 2—A floral bud in top view during tepal initiation. 3, 4—Floral buds in top views showing the sequence of tepal initiation. 5—A floral bud in side view where some of the tepal primordia were removed to exhibit first stamen primordia. 6, 7—Floral buds in side views showing successive stages of the formation of stamen primordia. 8—A floral bud in side view during the formation of first carpel primordia. (× 77)



Figs. 9-13. *Anemone vitifolia*. 9, 10—Floral buds in side views where tepal primordia were removed to exhibit successive stages of the formation of carpel primordia. 11-13—Floral buds in top views where tepal primordia were removed to exhibit successive stages of stamen and carpel development. Only some young carpels are shown in figure 12. (9, 10, 12×77; 11, 13×49)

(a—stamen primordium; an—anther; b—bracteole primordium; f—floral apex; fi—filament; g—carpel primordium; o—ovule primordium; p-tepal primordium).

some irregularities. A distinct whorled arrangement of stamens with vertical columns is found in *Aquilegia* (Tepfer, 1953).

In the present study, based on three-dimensional developmental stages, no distinct spiral arrangement of the stamens could be detected. The numerous stamens are initiated in five groups which extend laterally and vertically and eventually vertical and horizontal rows of stamen primordia become apparent. This arrangement is closer to a whorled condition, though there is disturbance due to some irregularities in the formation of stamen primordia. Thus, the arrangement of stamens in *Anemone* is somewhat intermediate between a typical spiral and whorled conditions.

The numerous carpel primordia are formed in alternation and in the sequence of the stamen primordia. They also appear in distinct vertical columns. Thus, the carpel primordia also do not show spiral arrangement.

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