ONTOGENY OF STOMATA OF SOME MEMBERS OF APOCYNACEAE*

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ABSTRACT

The present paper deals with the epidermal structures and development of stomata in three taxa, viz. *Tabernaemontana divaricata* R. Br., *Rauwolfia serpentina* L. and *Catharanthus roseus* (L.) G. Don. of Apocynaceae. Stomata are highly variable in their structure and ontogeny. Paracytic, anomocytic and anisocytic stomata have been observed in these plants. The paracytic stomata develop para-mesogenously, the anisocytic stomata aniso-mesogenously, whereas anomocytic stomata develop anomo-mesoperigenously.

INTRODUCTION

During recent years, epidermal studies have received considerable attention (PANT, 1965; STACE, 1961, 1965; VAN-COTTHEM, 1970; FRYNS CLASSENS & VAN-COTTHEM 1973; DILCHER, 1974). The epidermal structure of the family Apocynaceae has been worked out in some detail by KAPOOR *et al.* (1969) and TRIVEDI AND UPADHYAY (1973, 1974). The ontogeny of stomata and trichomes of this family, however, has not been worked out so far. In the present investigation, development of the stomata in three plants of this family, viz. *Rauwolfia serpentina* L., *Catharanthus roseus* (L.) G. Don., and *Tabernaemontana divaricata* R. Br. are reported in detail.

MATERIAL AND METHOD

Material for the present investigation was collected from the garden of Botany Department, Lucknow University, Lucknow. Young leaves at different developmental stages were fixed in acetic alcohol (1:3) and preserved in 70 per cent alcohol. For the study of developmental stages both fresh as well as young fixed leaves were used. Peelings of such leaves were stained in iron-haemotoxylin and mounted in canada balsam. The terminology used here is the same as suggested by FRYNS-CLAESSENS AND VAN-COTTHEM (1973).

OBSERVATION

Epidermal Characters—The leaves of *T. divaricata* are amphistomatic but those of *C. roseus* and *R. serpentina* are hypostomatic. In *T. divaricata* stomata are distributed on both the surfaces of leaves. The stomatal frequency is higher on the lower foliar surface. So far, only paracytic (rubiaceous) type of stomata have been reported in *C. roseus* and *R. serpentina*, and anomocytic (ranunculaceous) type of stomata in *T. divaricata*. We have,

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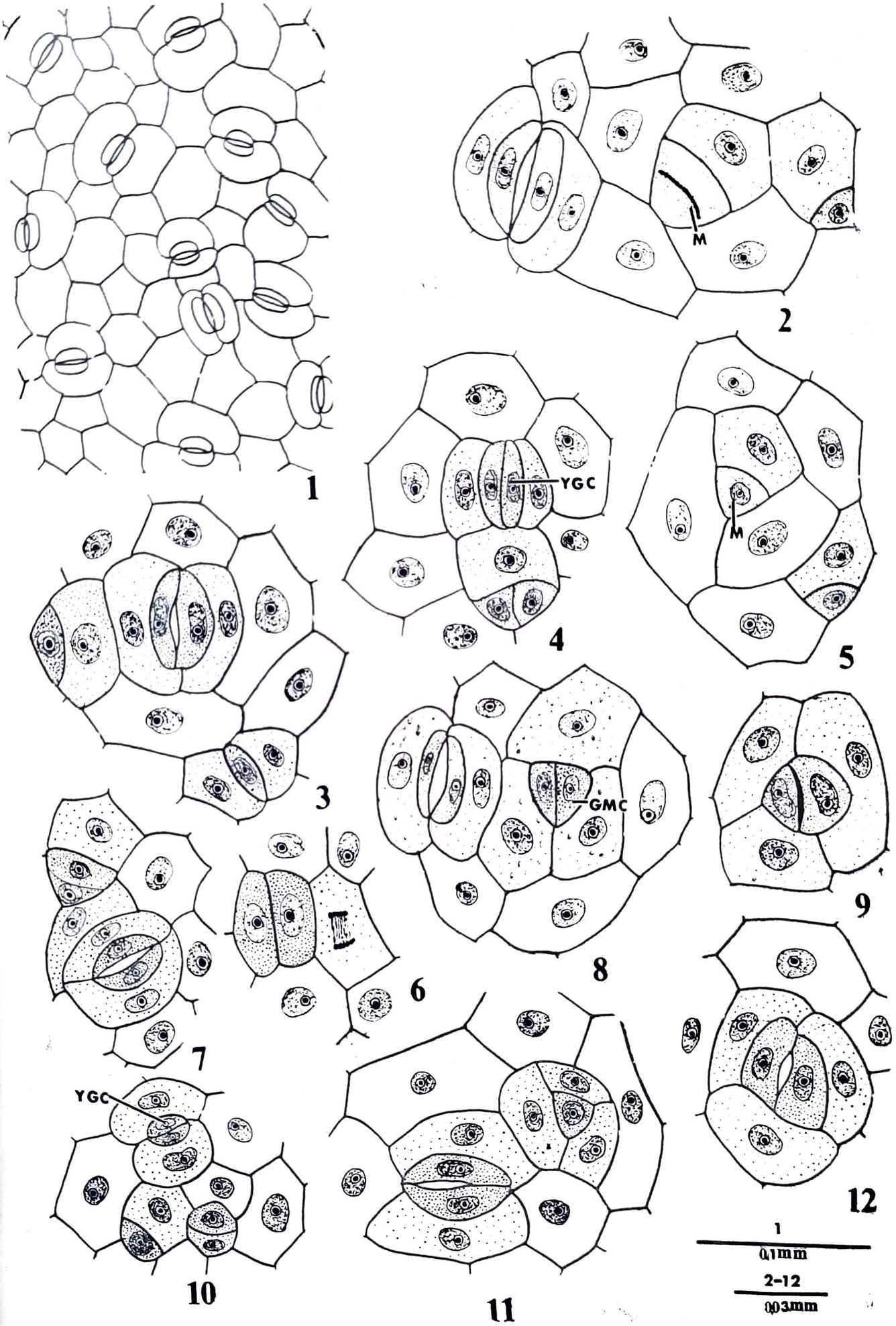
Text-figs. 1-12—*Catharanthus roseus*. 1. Lower epidermis showing the distribution of stomata. 2. Meristemoid with crushed nuclear material. 3. Mature stomata (Paracytic). 4. Developing stomatal apparatus showing two subsidiary cells and young guard cell in the middle. 5. Meristemoid with dense protoplats. 6. Enlarged meristemoid at anaphase. 7. Meristemoid showing second division parallel to the first division. 10. Guard cell mother cell showing division parallel to the subsidiary cells. (2-7 & 10. Development of paracytic type of stomata). 8-9. & 11. Guard cell mother cell with three subsidiary cells. 12. Typical anisocytic stomata with three subsidiary cells. (8-9. & 11-12. Development of anisocytic stomata).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2
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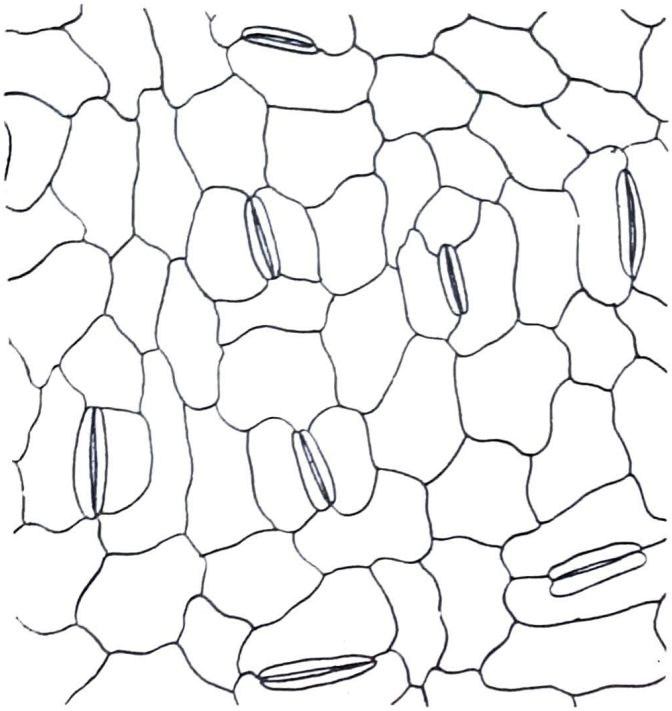

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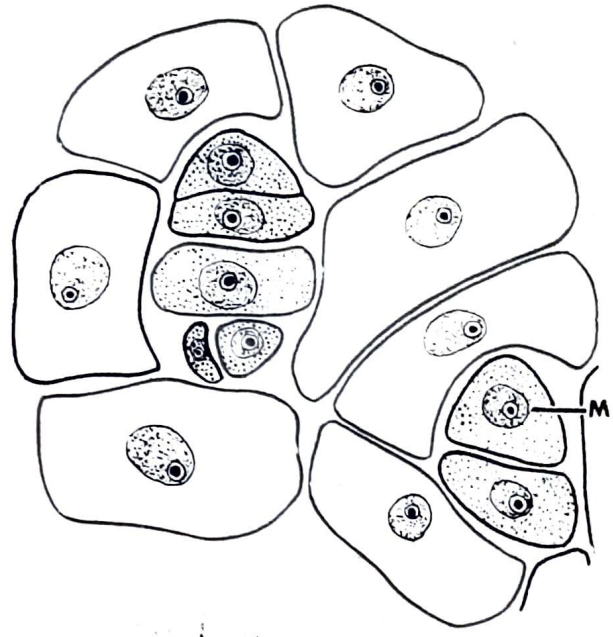

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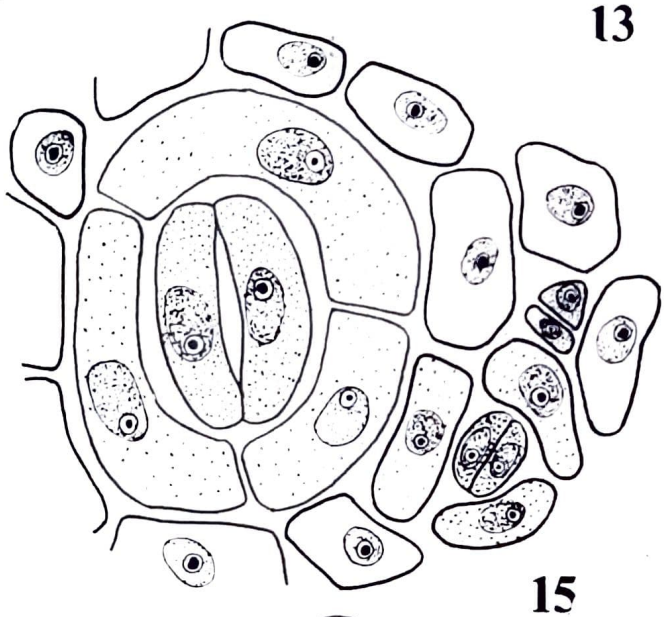

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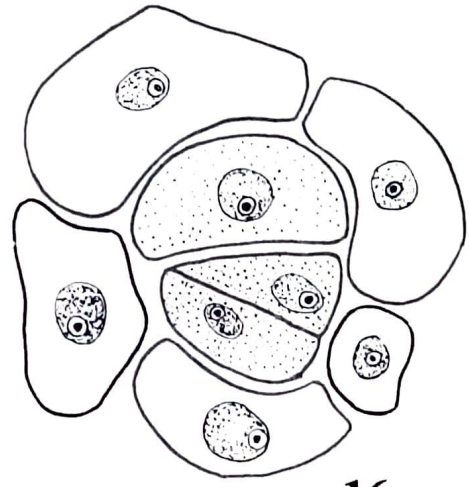

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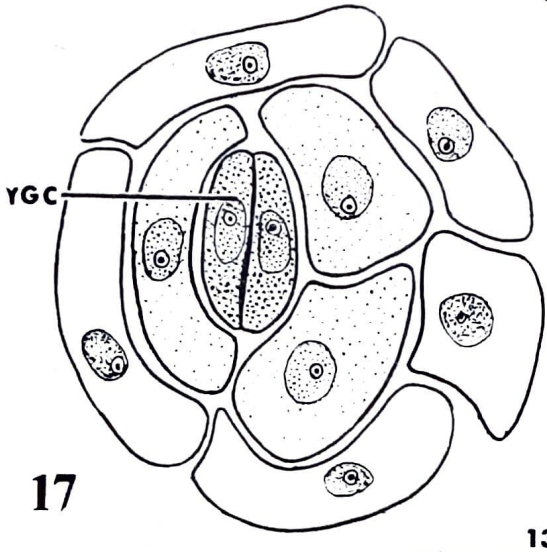

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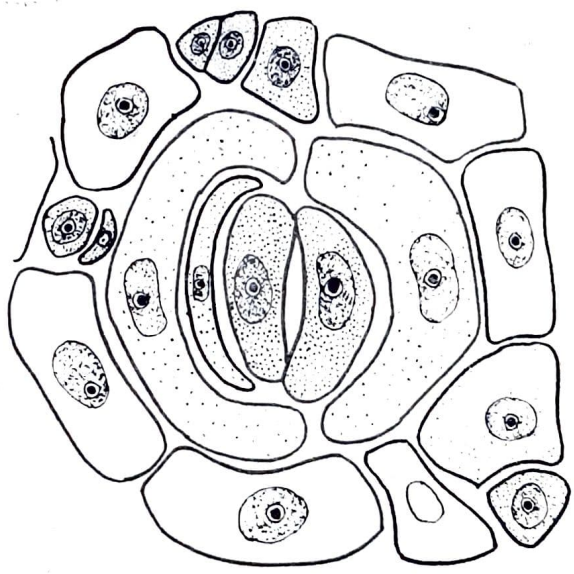


18

13
0.1 mm

14-18
0.03 mm

however, observed more than one type of stomata in each genus. Studies on stomatal development have revealed that there are three types of stomata in these plants.

(i) Para-mesogenous (paracytic type).

(ii) Aniso-mesogenous (anisocytic).

(iii) Anomo-mesoperigenous (anomocytic).

Development of Stomata—Protoderm cells occur scattered here and there in the epidermal cells of the young leaves of the investigated plants. These protoderm cells divide forming a small triangular and a large cell. In the young leaves of these plants many large cells in association with small triangular cells can be seen (Text-figs. 2, 5, 10). The large cell ultimately develops into subsidiary cells. The smaller, dark-coloured triangular cell—the meristemoid, divides by division parallel to the first wall; a wall is laid down and this results in the formation of another cell (Text-figs. 2, 6, 7). It has been observed that prior to division the meristemoid or stomatal initial enlarges, and subsequently a wall is laid down (Text-fig. 6). This gives rise to two unequal cells; successive walls are laid down alternately on opposite sides with their concavities facing each other (Text-fig. 4). Biconvex lenticular cells function as guard cell mother cells. These enlarge and then divide by a wall parallel to the previous one resulting in the formation of two equal cells (Text-figs. 4, 10). These cells mature into two lenticular cells—the guard cells. Intervening area between them functions as a stoma (Text-fig. 3).

Para-mesogenous—This type of stomata develop by either of the following two methods:

(i) The meristemoid undergoes four or more divisions to form two guard cells, two subsidiary cells and one large cell at right angles to the other cells of the stomatal apparatus (Text-fig. 4).

(ii) Here the other details remain the same as in the previous one except that large encircling cell lies parallel to the other cells of stomatal complex (Text-fig. 18).

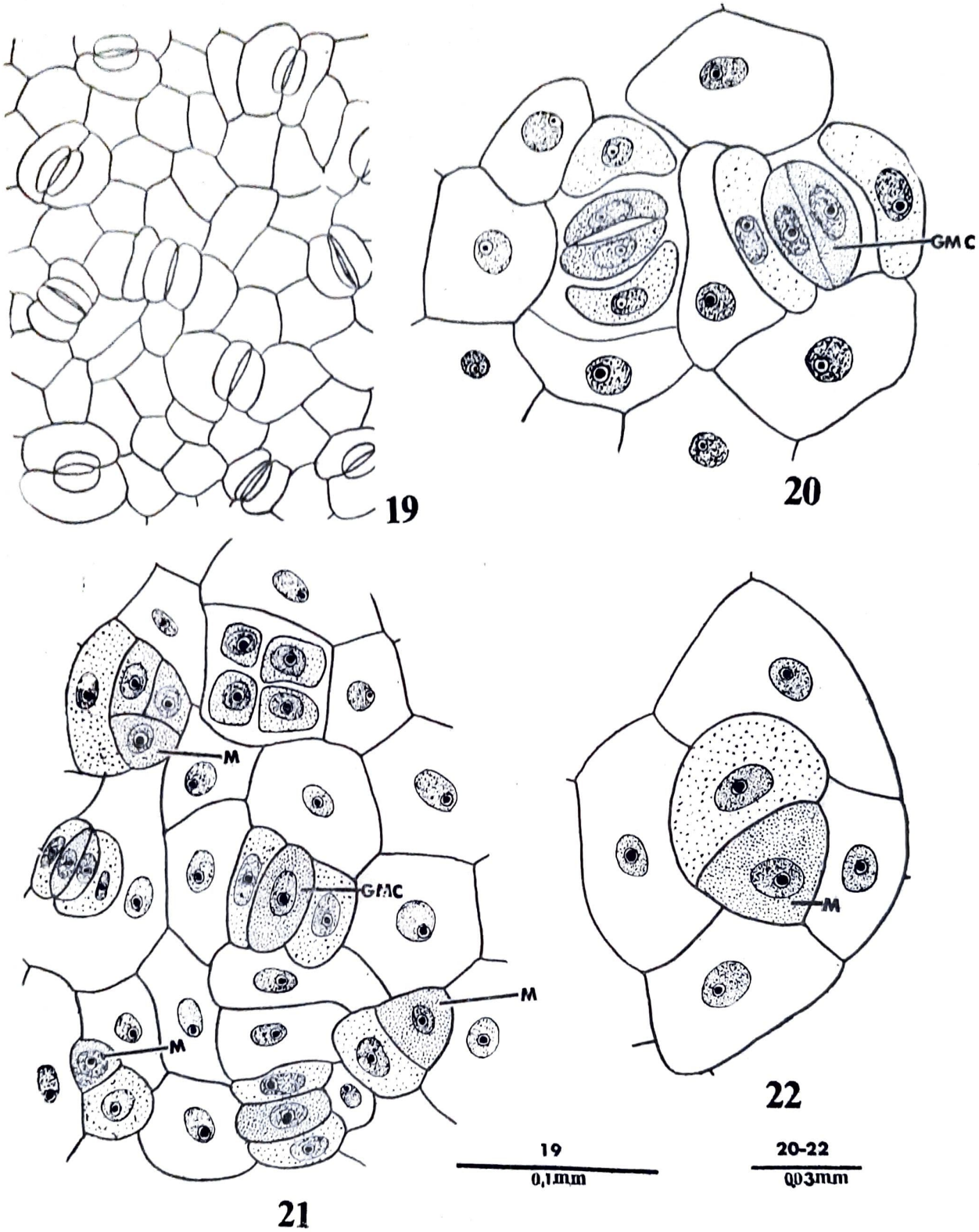
Aniso-mesogenous—The development of stomata in this case is essentially the same as in para-mesogenous type but here the meristemoid cuts off segments from three faces, with small triangular guard cell mother cell in the centre (Text-figs. 2, 5, 7, 8, 14). Three segments cut off by meristemoid become subsidiary cells at later stages, while the central guard cell mother cell divides in the median plane into two guard cells, in between the guard cells, a slit develops (Text-figs. 8-9, 12, 15, 17). Stomata formed in this way are called anisocytic or cruciferous type.

Anomo-mesoperigenous—Development of stomata again follows in either of the following two patterns:

(i) Meristemoid cuts off three segments as in aniso-mesogenous type. These get arranged in such a way that the meristemoid remains open on one side and latter gets covered by perigenous epidermal cell or cells (Text-fig. 21). The guard cell mother cell as usual divides into two guard cells by a median division.

(ii) In this case the meristemoid cuts off only two segments before giving rise to two guard cells. These segments, at a later stage, form subsidiary cells and thus extra subsidiary cells, develop perigenously (Text-fig. 20).

Text-figs. 13-18. *Rauwolfia serpentina*—13. Lower epidermis showing the distribution of stomata. 14. Meristemoid at different stages of division. 15. Meristemoid at second and third divisions, a stoma with three subsidiary cells. 16. Second division of meristemoid showing wall formation obliquely, instead of parallel to previous wall. 17. Guard cell mother cell at dividing stage with three subsidiary cells. 18. Paracytic stomata with three subsidiary cells parallel to guard cell of which one subsidiary cell is small.



Text-figs. 19-22. *Tabernaemontana divaricata*—19. Lower epidermis showing distribution of stomata. 20. Mature anomocytic stomata. 21. Meristemoid at different stages of development. 22. Meristemoid dividing parallel to the previous wall. (M, meristemoid; GMC, guard cell mother cell; YGC, young guard cell).

DISCUSSION

The epidermal structures of the family Apocynaceae are fairly well known. In the present investigation, we have studied the development of stomata in *C. roseus*, *R. serpentina*, and *T. divaricata*.

In case of *C. roseus* stomata are restricted to the lower foliar surface. Two types of stomatal development, aniso-mesogenous and para-mesogenous, have been recorded in this plant (Text-figs. 1-12). Similarly, in *R. serpentina* the mode of development of stomata are of two types, i.e. para-mesogenous and aniso-mesogenous (Text-figs. 13-18). The frequency of two types of stomata in *C. roseus* and *R. serpentina* varies considerably.

The number of stomata in *T. divaricata* on the lower surface of the leaf is almost twice as many as on the upper surface. The stomata in this plant are of two types, viz. paracytic and anomocytic and their development is para-mesogenous and anomo-mesoperigenous (Text-figs. 19-22). Abnormal stomata of this family have already been reported by us (TRIVEDI & UPADHYAY, 1974).

So far only anomocytic and paracytic type of stomata have been reported from this family (METCALFE & CHALK, 1950). Anisocytic type of stomata are not known. We have observed anisocytic (cruciferous) stomata in *C. roseus* and *R. serpentina*.

Only paracytic types of stomata are found in *C. roseus* and *R. serpentina* (METCALFE & CHALK, 1950). We have on the other hand observed two types of stomata in these plants (Table 1). Similarly, in *T. divaricata* all the stomata were supposed to be only anomocytic type (METCALFE & CHALK, 1950), whereas our findings indicate the presence of two kinds of stomata, viz. anomocytic and paracytic types. Our observations, thus, clearly indicate the presence of three distinct types of stomata, viz. anomocytic, paracytic and anisocytic in the genera studied by us in the family Apocynaceae.

Table 1

Name of the plant	Distribution of stomata	Percentage of different types of stomata				Mode of development
		Paracytic	Anisocytic	Anomocytic	Diacytic	
Catharanthus roseus (L.) G. Don	Lower surface	65	35	—	—	Para-mesogenous & aniso-mesogenous
Rauwolfia serpentina L.	Lower surface	61	39	—	—	Para-mesogenous & aniso-mesogenous
Tabernaemontana divaricata R. Br.	Both surfaces	30	—	70	—	Anomo-mesoperigenous

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