CLASSIFICATION OF STOMATAL TYPES

The stomata are minute pores which occur in the epidermis of the plants. Each stoma remains surrounded by two kidneys or bean shaped epidermal cells the guard cells. The stomata may occur on any part of a plant except the roots. The epidermal cells bordering the guard cells are called accessory cells or subsidiary cells.

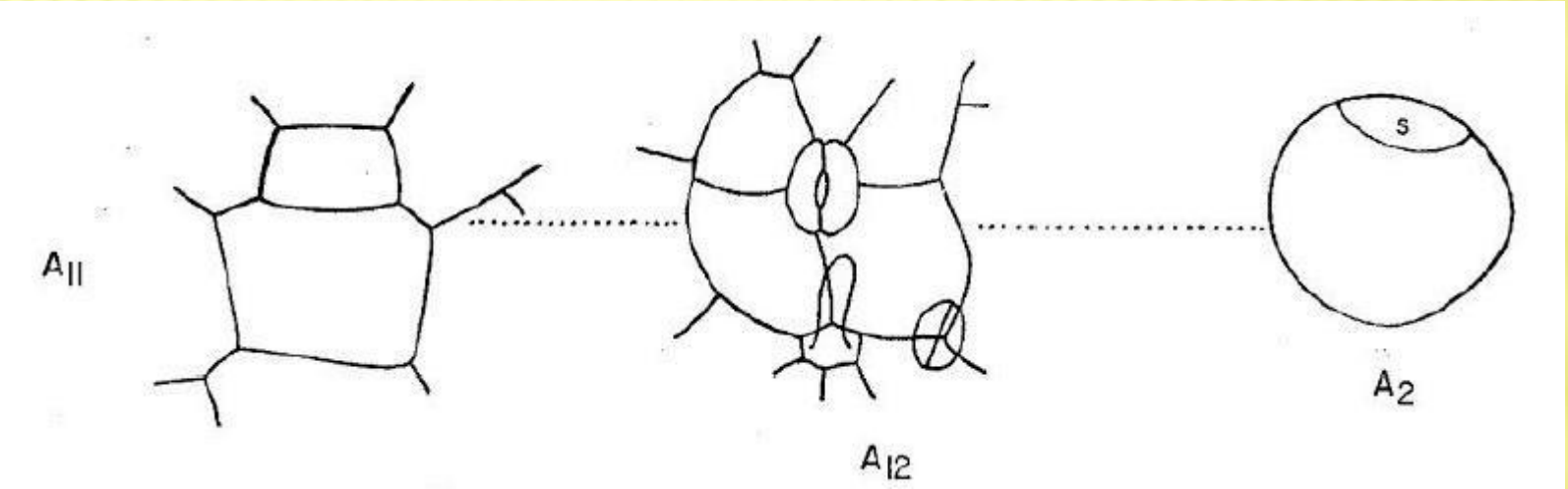
Generally the term stoma is applied to the stomatal opening and the guard cells. The guard cells are living and contain chloroplasts in them. They also contain a larger proportion of protoplasm than other epidermal cells. Usually in the leaves of dicotyledons the stomata remain scattered whereas in the leaves of monocotyldons they are arranged in parallel rows.

The number of stomata may also range on the surface of a single leaf from a few thousand to hundreds of thousands per square centimetre. Stomata occur on both upper and lower surfaces of leaf, but especially they are confined to the lower surface. In floating leaves Stomata are confined only on the upper surface of the leaf.

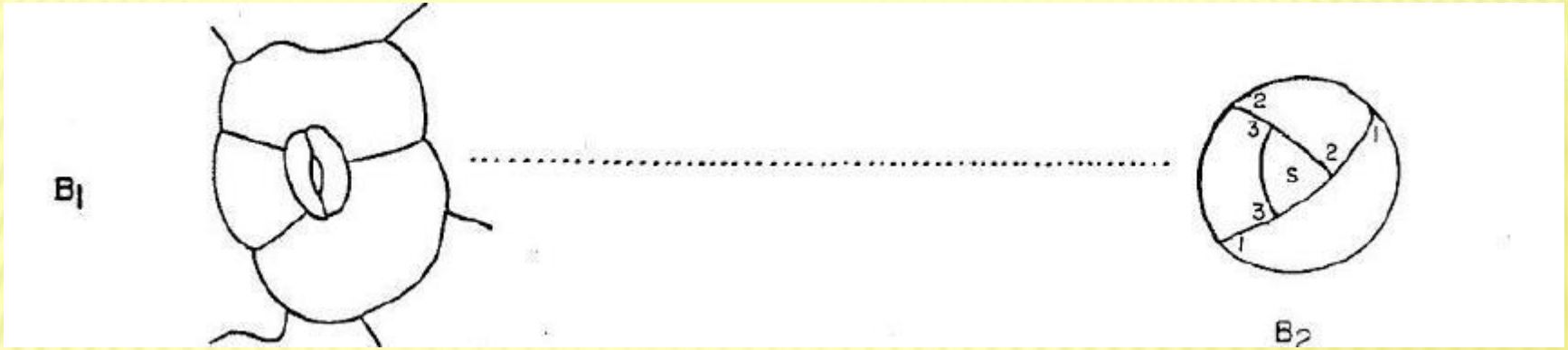
A. MORPHOLOGICAL OR TOPOGRAPHICAL CLASSIFICATION:

The dicotyledons stomata were firstly classified into 4 types by Vesque in the year 1889. The names for your types were given after the family in which these types were first studied. The four types as defined by Vesque (1889) are as follows:

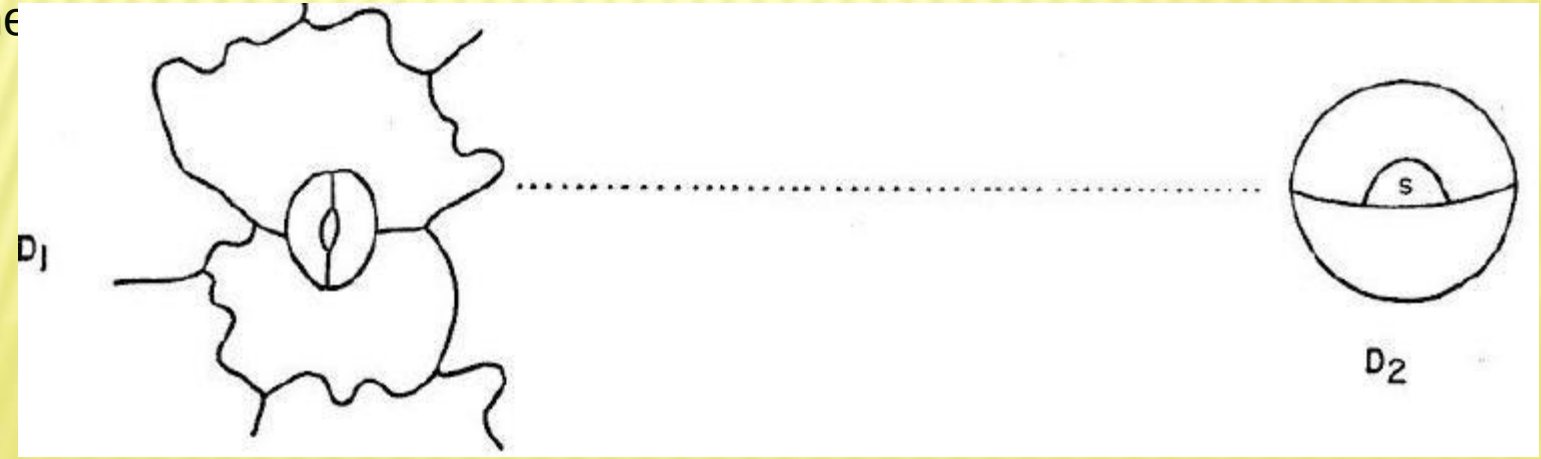
(i) **Ranunculaceous type:** Stoma mother cell is cut off by a simple U-shaped wall; mature stomata are surrounded by several irregularly disposed epidermal cells.



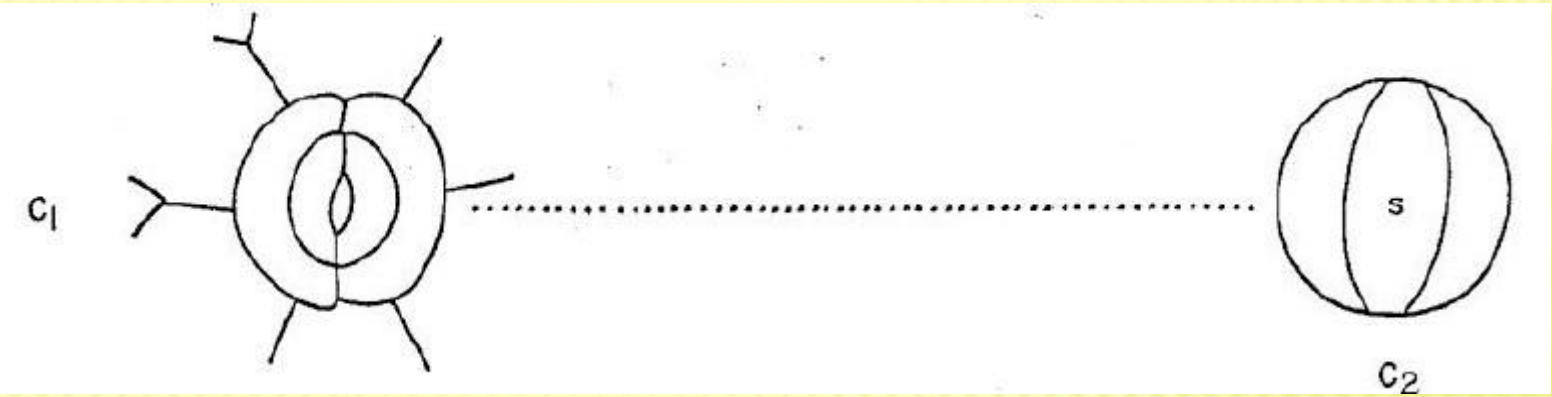
(ii) **Cruciferous type**: The stoma mother cell is cut off in the primordial cell by three or more cell walls inclined to one another at an angle of about 60°; mature stomata are surrounded by three subsidiary cells, of which one is, smaller than the other two.



(iii) **Caryophyllaceous or Labiateous type:** Stoma mother cell is cut off into the primordial cell by two U-shaped cell walls oriented in opposite directions, the second being attached to the concavity of the first, mature stomata are suspended in the middle of an epidermal cell by two cell walls perpendicular to the



(iv) **Rubiaceous type**: Stoma mother cell is cut off in the primordial cell by two parallel walls; mature stomata are accompanied by two subsidiary cells parallel to the long axis of the pore.

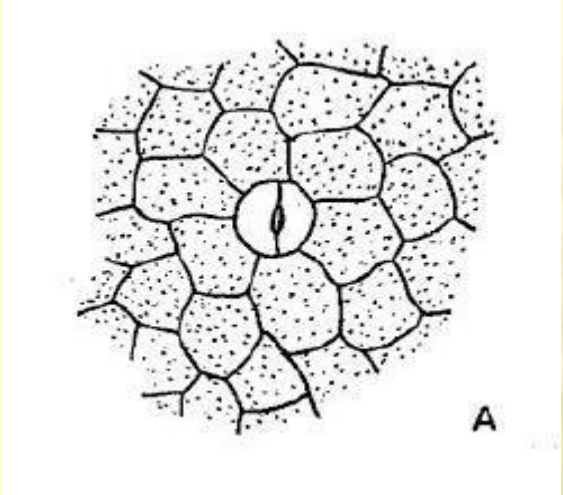


In order to remove the impression that the particular type of stomata are not restricted to certain families only;

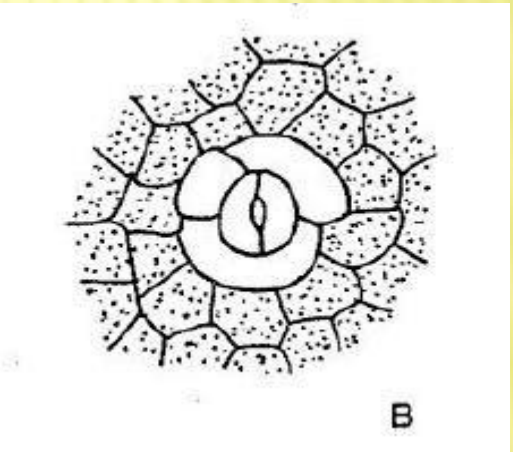
Metcalfe and Chalk (1950) replaced these terms by more general descriptive ones: "anomocytic" for "ranunculaceous", "anisocytic" for "Cruciferous"; "diacytic" for "Caryophyllaceous" or "labiateous" and "paracytic" for "rubiaceous".

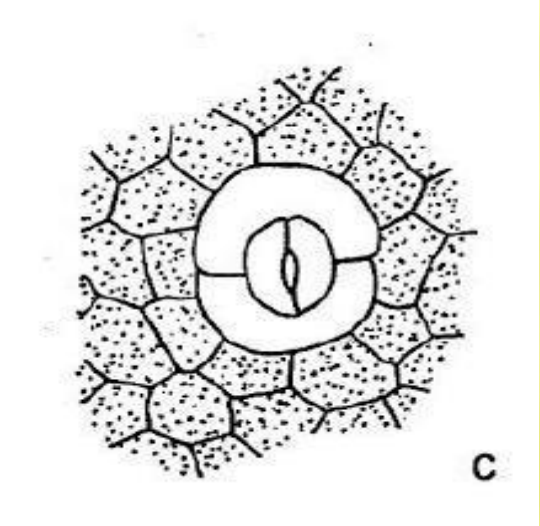
Since Metcalfe and Chalk (1950) proposed these terms; they have been in use in most research papers to indicate the structure and position of the epidermal or subsidiary cells. The different terms of Metcalfe and Chalk (1950) are defined as under:

(i) **Anomocytic (irregular-celled**) type: The stoma is surrounded by a definite number of cells that are not different from the remainder of the epidermis.



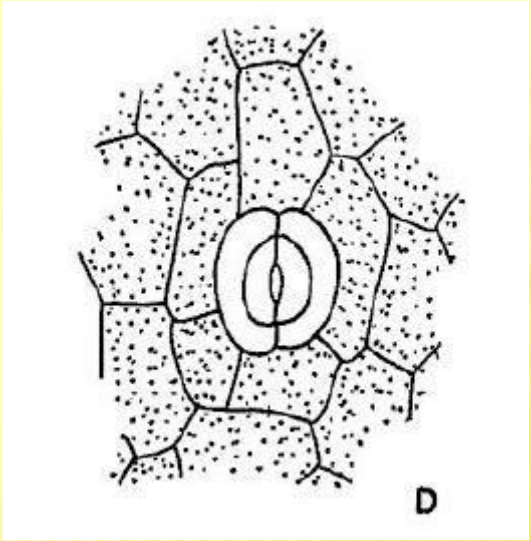
(ii) Anisocytic (unequal celled) type: The stoma is surrounded by three cells of which one is distinctly smaller than the other two.





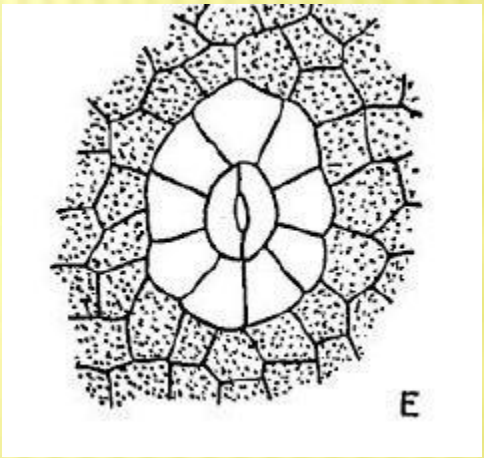
(iii) Diacytic (Cross-celled) type:
The stoma is enclosed by a pair of subsidiary cells whose common wall is at right angles to the guard cells.

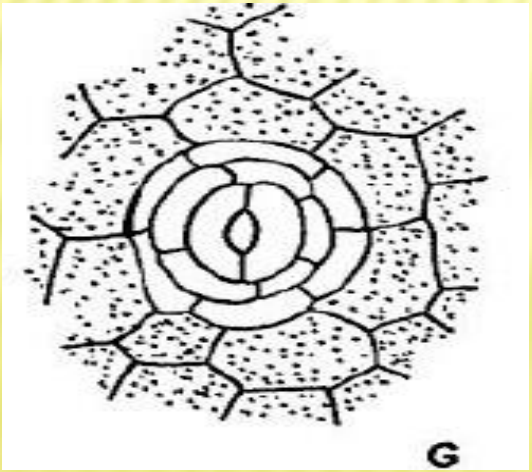
(iv) Paracytic (parallel celled) type: The stoma is accompanied on either side by one or more subsidiary cells parallel to the long axis of the pore and guard cells.



The following morphological terms have been added to this list:

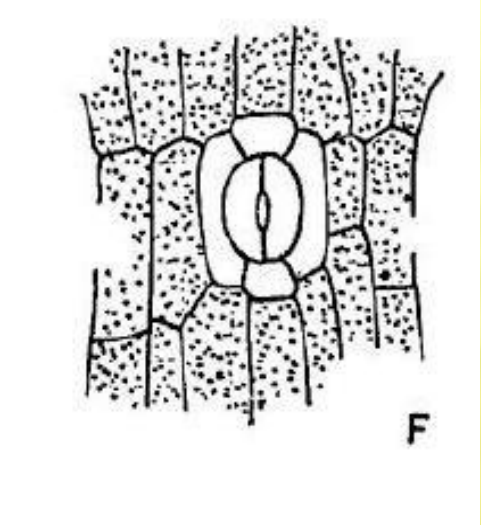
(v) **Actinocytic type**: The stoma is surrounded by a circle of radiating cells (Metcalfe and Chalk, 1950).





(vi) **Cyclocytic type**: The stoma is surrounded by 4 or more cells forming a narrow ring around the guard cells (Stace, 1965)

(vii) **Tetracytic type**: The stoma is surrounded by four subsidiary cells, 2 lateral and 2 polar, the polar sometimes smaller and roundish (Metcalfe,1961).



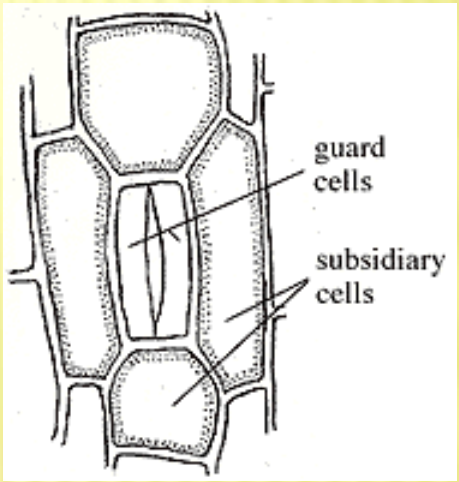
(viii) **Stoma with a single subsidiary cell**; : The stoma is accompanied by a single subsidiary cell either shorter or longer than the guard cells and which mostly lie parallel to the long axis of the pore. Van Cotthem (1970) designated this as a hemiparacytic.

B. MORPHOGENETIC OR ONTOGENETIC CLASSIFICATION:

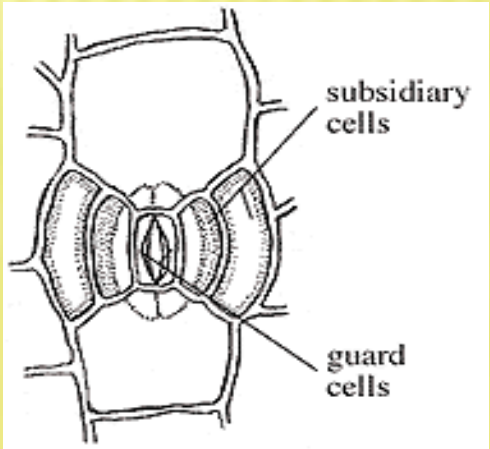
The stoma mother cell or stomatal initial called the **meristemoid** is cut off from a cell of the protoderm. The stomatal initial undergoes one or more divisions to give rise to a stoma. A stomatal meristemoid which divides to form two equal guard cells is called a guard mother cell.

Florin's classification (1931, 1955): The gymnosperm stomata were classified into two following ontogenetic types by Florin (1931, 1933):

(i)Haplocheilic type: A stoma mother cell directly dunctions as a guard mother cell which divides to produce a pair of guard cells only without cutting off any subsidiary cells.



(ii)Syndetocheilic type: A stomatal initial functions as a guard mother cell after cutting off one or more subsidiary cells.



After the publication of Florin's (1931, 1933)work, many research workers used these ontogenetic terms for the description of mature stomata too on the basis of presence or absence of subsidiary cells. Then, later on it was proved that neither the presence of many subsidiary cells did not always necessarily involved a syndetocheilic ontogeny; nor did the absence of subsidiary cells involved always a haplocheili ontogeny.

Florin (1933), therefore, proposed to replace the terms "**mesogenous**" for syndetocheilic and "**perigenous**" for haplocheilic to indicate that the epidermal cells around the stoma (neighbouring or subsidiary cells) develop or not from the same stomatal initial as the guard cells.

(iii) **Mesoperigenous**: This term is coined by Pant (1965) to this ontogenetic classification of the stomatal types to denote that the surrounding cells are of dual origin, at first typically one mesogene neighbouring cell and guard mother cell are formed from the meristemoid, while the remaining perigene are those which happen to lie on the other side of the meristemoid.

Pant's classification (1965): Pant (1965) divided these three main types mesogenous, mesoperigenous and perigenous into ten subtypes as follows:

1. Mesogenous are further subdivided depending upon the number of cutting faces of the meristemoid which corresponds to the number of subsidiary cells:

(i) Unilabrate
(ii) Dolabrate
(a) Mesoparacytic
(b) Mesodiacytic
(c) Pyrrosia type
(i) Trilabrate
(ii) Tetralabrate

2. Mesoperigenous subdivided on the basis of plane of division of the guard mother cell:

(i) Plagiogyria type (at right angles)
(ii) Tetracentron type (parallel)
(iii) Ranunculus type (at any angle)

3. Perigenous type: All of the cells surrounding the guard cells originate independently of the maternal cell of the guard cells. The maternal cell divides only once, producing the two guard cells. It is the same as the haplocheilic type of Florin.