THE DERMAL OR EPIDERMAL TISSUE SYSTEM

The dermal system forms the outer protective covering of the plant and is represented, in the primary plant body, by the epidermis. During secondary growth the epidermis may be replaced by another dermal system the periderm, with the cork cells forming the new protective tissue.

EPIDERMIS

The epidermis usually consists of a single layer of cells which cover the whole outer surface of the plant body. The word is derived from two words of Greek origin, *epi*, upon, and *derma*, skin. It is a continuous layer except for certain small pores, called stomata and lenticels. According to the histogen theory introduced by Hanstein in 1870, it is derived from dermatogen of apical meristem. In meristematic regions it is, of course, unidifferentiated, and in older stem and roots it may have been destroyed by secondary growth. Mostly the epidermis is single layered, but in many plants it has been described as bi-or multiseriate. In the leaves of India rubber plant (*Ficus elastica*), banyan tree (*Ficus bengalensis*), oleander (*Nerium* spp.), etc. It becomes two to multilayered. The epidermal cells may be somewhat irregular in outline, usually varying in shape and size and arranged very close to each other having no intercellular spaces among them. The cells possess a large central vacuole and thin peripheral cytoplasm. The cells may contain leucoplasts, anthocyanins and chromoplasts, but no chloroplasts except in guard cells. In the epidermal cells of certain aquatic (e.g. *Hydrilla*) and shade loving plants the chloroplasts are also found. Sometimes, the substances like mucilage, tannin and calcium carbonate crystals (**cystoliths**) are also found in these cells. The walls of epidermal cells are unevenly thickened. The inner and radial walls are comparatively thicker. This additional thickness is due to the impregnation of suberin or cutin. The suberization and cutinization of the walls protect the epidermis from mechanical injuries and prevent from loss of water.

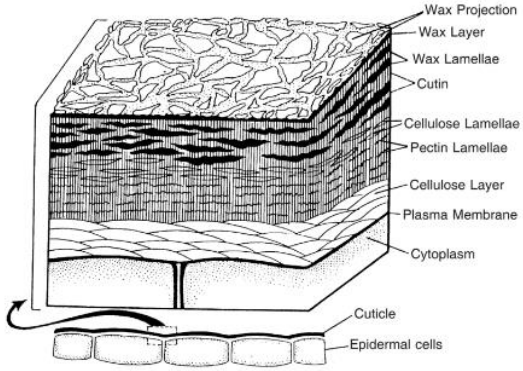

FIG. 10.1 Epidermis. Schematic representation of the structure and composition of the cuticle and cell wall of foliar epidermal cells.

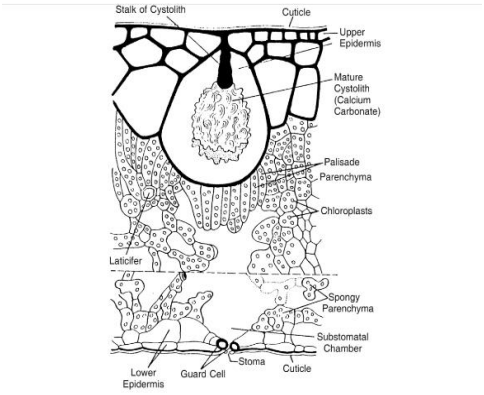

FIG. 10.5 Epidermis. Multiple epidermis in T.S. of *Ficus elastica* leaf. A mature cystolith with calcium carbonate deposited on its stalk in the epidermal cell.

In the case of roots the outermost layer is known as the epiblema. piliferous layer or rhizodermis. Usually its cells extend outwards in the form of tubular unicellular root hairs, which help in the absorption of water and mineral nutrients from the soil.

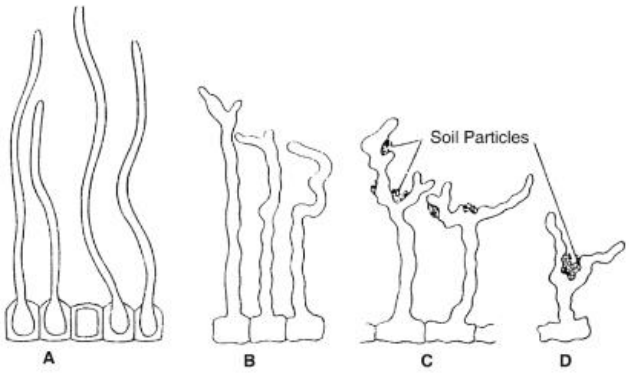

FIG. 10.6 Root hairs, A, grown in water; B, grown in moist soil; C and D, grown in dry soil (*after* Schwarz).

Functions of the Epidermis

1. The epidermis is primarily a covering layer which helps in the protection of the internal soft tissues against mechanical injury.

2. It prevents excessive evaporation of water from the internal tissues, for this, several adaptations like development of thick cuticle, wax, hairs, etc., take place.

3. It also serves in photosynthesis and secretion.

4. The epidermis acts as store house of water in many xerophytic plants.

5. Some of the epidermal cells develop into the secretory tissues of nectaries, the stomats of leaves and stems, and the absorbing hairs of roots.

CUTICLE

A plant cuticle is a protecting film covering the epidermis of leaves, young shoots and other aerial plant organs without periderm. It consists of lipid and hydrocarbon polymers impregnated with wax, and is synthesized exclusively by the epidermal cells.

The cuticle is composed of an insoluble cuticular membrane impregnated by and covered with soluble waxes. Cutin, a polyester polymer composed of inter-esterified omega hydroxy acids which are cross-linked by ester and epoxide bonds, is the best-known structural component of the cuticular membrane. The cuticle can also contain a non-saponifiable hydrocarbon polymer known as Cutan.

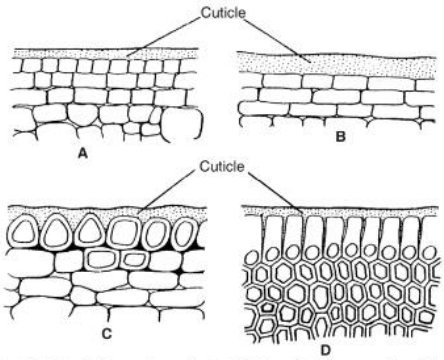

FIG. 10.2 Cuticle. A, in fruit of *Citrus sinensis*; B, in fruit of *Malus pumila*; C, in *Dracaena* stem; D, in leaf of *Dasylirion serratifolium* (*after* Eames and MacDaniels).

Functions of cuticle

1. The primary function of the plant cuticle is as a water permeability barrier that prevents vaporation of water from the epidermal surface, and also prevents external water and solutes from entering the tissues.
2. In addition to its function as a permeability barrier for water and other molecules (prevent water loss), the micro and nano-structure of the cuticle have specialised surface properties that prevent contamination of plant tissues with external water, dirt and microorganisms.

STOMATA

The stomata are minute pores which occur in the epidermis of the plants. Each stoma remains surrounded by two kidney 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. Under normal conditions the stomata remain closed in the absence of light or in night or remain open in the presence of light or in day time.

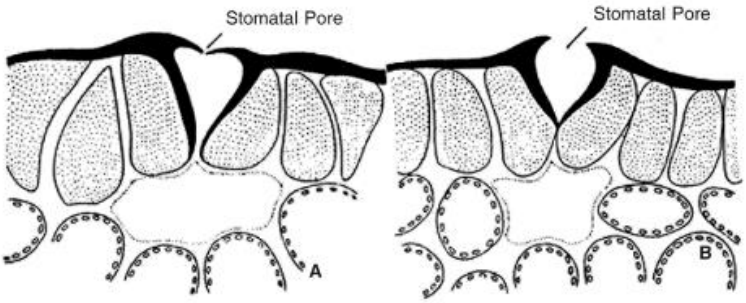

FIG. 10.12 Stomata. A—B, closed and open stomatal pores.

Structurally the stomata may be of different types. The four main types of stomata which occur in dicotyledons are known as Ranunculaceous or anomocytic type-type A; Cruciferous or anisocytic-type B; Caryophyllaceous or diacytic-type C; Rubiaceous or paracytic-type D. the fifth type of stomata is commonly found in monocotytledons are known as-gramineous type.

1. Ranunculaceous or anomocytic. Type A-(Anomocytic - irregular celled). In this type the stoma remains surrounded by a limited number of subsidiary cells which are quite alike the remaining epidermal cells. The accessory or subsidiary cells are five in number.

2. Cruciferous or anisocytic. Type B- (Anisocytic unequal celled). In this type stoma remains surrounded by three accessory or subsidiary cells of which one is distinctly smaller than the other two.

3. Rubiaceous or paracytic. Type C-(Paracytic parallel celled). In this type, the stoma remains surrounded by two subsidiary or accessory cells which are parallel to the long axis of the pore and guard cells.

4. Caryophyllaceous or diacytic. Type D-(Diacytic cross celled)--In this type the stoma remains surrounded by a pair of subsidiary or accessory cells and whose common wall is at right angles to the guard cells.

5. Gramineous. The gramineous stoma possesses guard cells of which the middle portions are much narrower than the ends so that the cells appear in surface view like dump-bells. They are commonly found in Gramineae and Cyperaceae of monocotyledons.

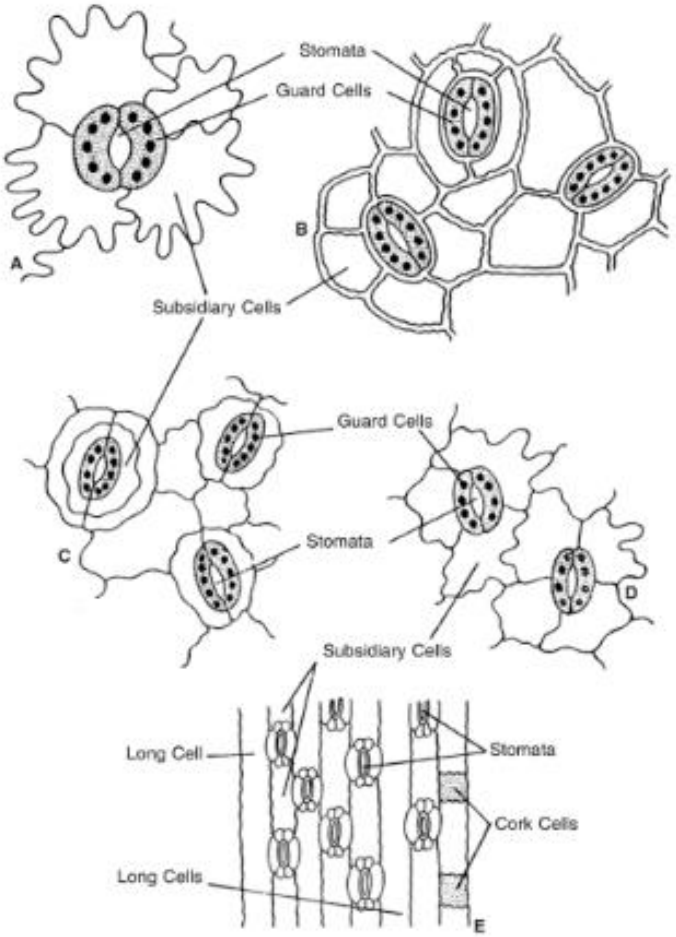

FIG. 10.18 Types of stomata. A, anomocytic or irregular-celled type (ranunculaceous type); B, anisocytic or unequal-celled type (cruciferous type); C, paracytic or parallel-celled type (rubiaceous type); D, diacytic or cross-celled type (caryophyllaceous type); E, gramineous type.

Function of Stomata

They are used for the exchange of gases in between the plant and atmosphere. To facilitate this function, each stoma opens in a sub-stomatal chamber or respiratory cavity. Evaporation of water also takes place through stomata

HAIRS OR TRICHOMES

Some of the epidermal cells of most plants, grow out in the form of hairs or trichomes. They may be found singly or less frequently in groups. They may be unicellular or multicellular and occur in various forms. They vary from small protuberances of the epidermal cells to complex branched or stellate multicellular structures. The cells of the hairs may be dead or living. Very frequently the hairs lose their protoplasm in their cells.

The hairs may be of several types, as-stinging hairs; laticiferous hairs, bladder like hairs mucilage hairs, arachnoid hairs, calcified or silicified hairs, non-glandular shaggy hairs, glandular shaggy hairs, non-glandular tufted hairs, two-armed non-glandular hairs, stellate glandular hairs, branched non-glandular hairs, branched glandular hairs, capitate sessile hairs glandular capitate stalked hairs, non-glandular peltate hairs, glandular peltate hairs and uniseriate hairs.

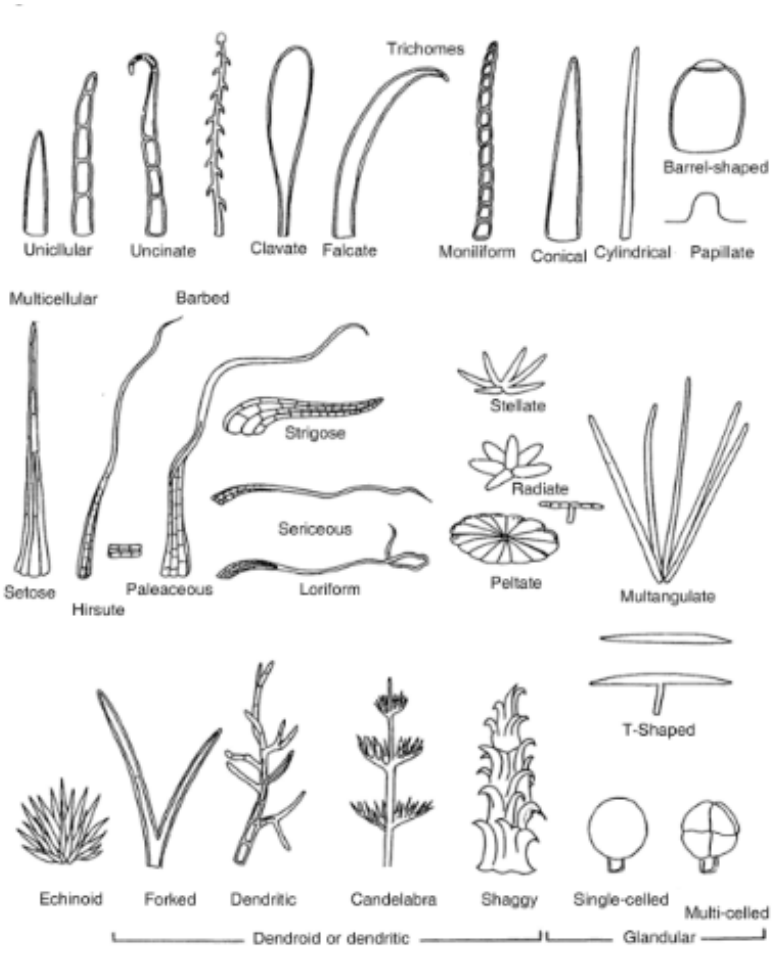

FIG. 10.22 Trichomes of different types.

Trichomes may be classified into different morphological categories. One common type is referred to as hair. The hairs may be subdivided into (i) unicellular; and (ii) multicellular. The unicellular hairs may be unbranched or branched. Multicellular hairs, may consist of a single row of cells or several layers. Some multicellular hairs are branched in dendroid (tree-like) manner, others have branches oriented largely in one plane (stellate hairs.)

Some important types have been described here.

1. **Stinging hairs**: They are one of the most interesting types of the trichomes, it contains a poisonous liquid and consists of a basal bulb like portion from which a stiff, slender

and tapering structure is given out. This tapering structure ends in a small knob like or a sharp point. The tip is usually somewhat oblique, and as the body of an animal or human being comes in its contact with some force, the tip is broken off, and the sharp pointed end readily penetrates the skin of the animal, and fluid is being transferred from the basal knob of the hair to the body of the animal.

2. **Glandular hairs**: Many plants possess glandular hairs. These hairs may secrete oil, resin or mucilage. A typical glandular hair possesses a stalk and an enlarged terminal portion, which may be referred to as gland. The glandular hairs may be uni- or multicellular. Active secretory cells of glandular trichomes have dense protoplasts and elaborate various substances, such as volatile oils, resins and mucilages, and gums. These substances are excreted and accumulate between the walls and cuticle. Their final removal from the hair occurs by rupture of the cuticle.
3. **Scale or peltate hair**: A common type of trichome is the scale, also called peltate hair (from the fatin peltatus, target-shaped or shield like, and attached by its lower surface). A scale consists of a discoid plate of cells, often borne on a stalk or attached directly to the foot.

Functions of Trichomes:

A dense covering of woolly trichomes controls the rate of transpiration. They also reduce the heating effect of sunlight. They aid in the protection of plant body from outer injurious agencies.