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Histology of the Corn Leaf

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The stem bears lateral organs, the leaves. These occur at definite points, the nodes, and originate in an exogeneous manner. The leaf arises in the form of a papilla and is not covered by the superficial tissue as the root is. The mature leaf is divided into two parts, the blade and the sheath. At the base of the blade occurs the membranaceous ligule. The veins of the leaf are parallel and are continuous with those of the sheath. The vascular bundles of the sheath connect with those of the stem. The function of the leaf is the preparation of food by a process known as photosynthesis. This same function is also shared by the sheath and stem, but not in nearly so marked a degree.

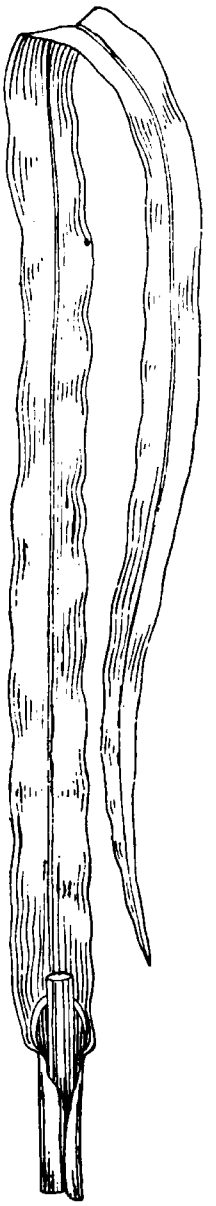

Fig. 11.
Leaf of corn showing sheath, ligule, and blade

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The sheath in cross section shows (Plate IX), beginning at the inner or upper surface, the epidermis of large, thin-walled cells, immediately inside of which is stereome in patches, which are located opposite the large bundles on the outer side. Then comes the inner area of the sheath, made up of large, polygonal, colorless, thin-walled parenchyma cells.

The outer or lower surface of the sheath presents an entirely different aspect and varies greatly with the variety of corn. Generally speaking, it is more or less ribbed, caused by the large fibrovascular bundles. The creases have colorless unicellular hairs which are usually not developed on the epidermis over the bundles. The epidermal cells are small and thick-walled, serving together with the hairs to protect the plant against drouth and other injuries. Beneath the outer epidermis occur the bundles referred to above, usually with intervening smaller ones, but this varies with different corns. For example, a Mexican corn (No. 1) shows two sizes of bundles not connected with each other, forming no external ridges, and the epidermis shows only a few very short spur-like hairs, while a form from South America shows heavy ridges, many hairs, and only one kind of regular sized bundles.

In all cases there exists an area of stereome between the bundles and the outer epidermis.

The only chlorophyll in the sheath is located in the chlorophyll parenchyma sheath which surrounds the bundles, except a portion on the outer side which is occupied by stereome.

The leaf-blade is made up of the midrib or keel and the blade proper. On each side occur the veins with the fibrovascular bundles. A cross section of the leaf shows the keel (Plate X), on the upper or inner surface the epidermal cells are small, rather thin-walled, and immediately underlying which are several layers of stereome or sclerotic cells, which gradually increase in number, and toward the margin of the keel only occur in patches over the large bundles on the lower or outer side, and as the keel merges into the blade proper the stereome areas unite with the sheath of the large bundles. On the lower or outer surface the epidermal cells are thick-walled.

Three different kinds of bundles occur within the keel, regularly arranged as follows: The large, perfect bundles connected with the lower epidermis by a broad area of stereome, and a line of chlorophyll parenchyma down each side, but not

connected. Midway between the large bundles are small ones (Fig. 12), connected with the epidermis by a narrow, wedge-

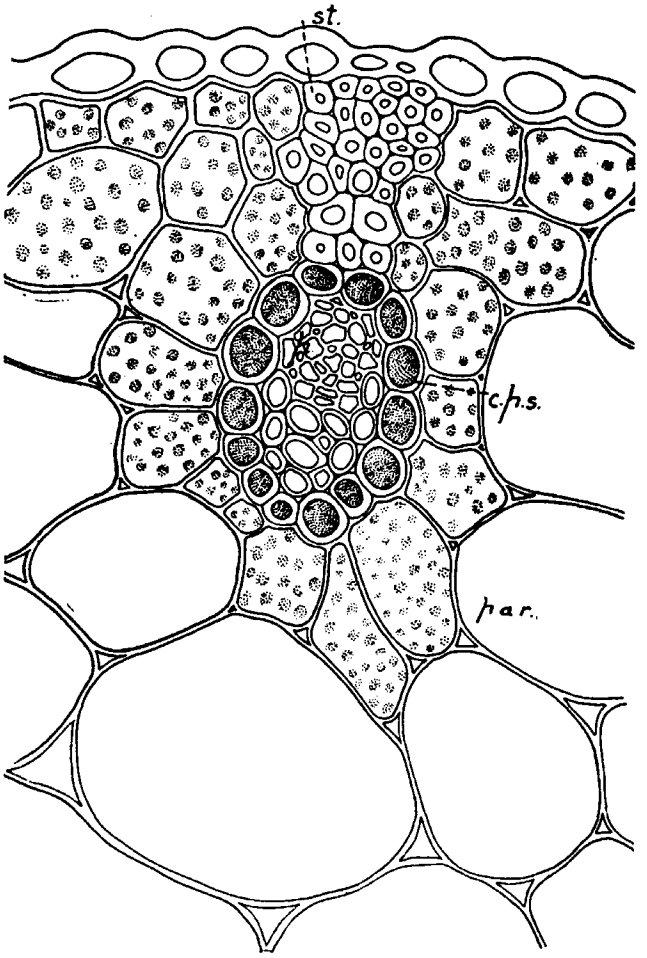


Fig. 12.

Cross section of keel, lower side, showing secondary bundle with its parts, surrounded by mesophyll, *c. p. s.*, chlorophyll parenchyma sheath; *p.* phloem; *st.* stereome; *par.* colorless parenchyma. (Original.)

shaped area of stereome, and almost surrounded by a thick-walled chlorophyll parenchyma sheath, and this sheath by another thin-walled one which might be called the mesophyll sheath.

Midway between each large and small bundle is usually a smaller one, isolated, and entirely surrounded by a double sheath, one of thick-walled chlorophyll parenchyma, and the second of thin-walled mesophyll. These are true mestome bundles, like those of the blade proper.

The area not occupied by stereome, between the outer epidermis and the bundles, is occupied by chlorophyll parenchyma or mestome.

Between the bundles and the upper or inner epidermis is the pith, made up of colorless parenchyma; this makes up the body of the keel.

The blade proper, in surface section of the superior or inner face (lower figure, Plate XI), shows epidermal cells irregularly rectangular in shape, with a wavy or dove-tailed outline. Between the ends of the cells is often a small, spur-shaped protuberance or hair. The long stomata are located between the ends of the cells of every third or fourth row. Their regularity in shape and arrangement is more or less interfered with along the bulliform areas. In addition to the stomata, which are moisture regulators serving also in the exchange of gases, rifts from which water exudes occur at the apex of growing corn leaves.

The bulliform areas are composed of from three to seven rows of polygonal cells with thin walls, are arranged longitudinally with the leaf, and are occasionally interrupted by or grade into the exserted cells about the base of the large hairs. These areas are usually about fourteen rows of epidermal cells from each other, and are located alternately with the veinlets. The epidermis of the lower or outer face is much the same as above, except that bulliform cells, hairs, and spur-like hairs or tubercles, are wanting and the walls are thicker.

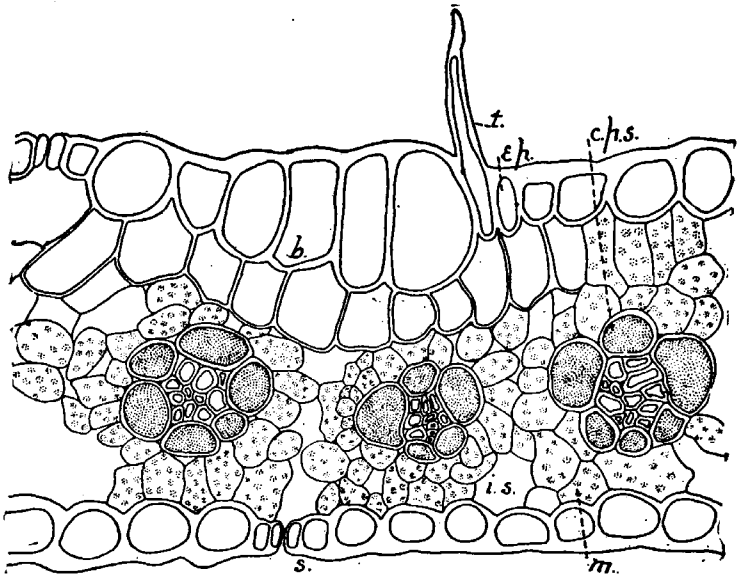


Fig. 13

Cross section of leaf blade showing: *b*, normal bulliform area with *t*, short spur-like hair; *ep.*, epidermal cells of upper surface; *c. p. s.*. cholorophyll parenchyma sheath of mestome bundle embedded in the mesophyll; *m.*, mesophyll; *i. s.*, intercellular space; *s*, stoma.

In cross section (upper figure, Plate XI), the epidermal cells of the two sides appear much alike in shape and size, the lower having a much thicker cuticle, and no hairs or bulliform cells.

The upper or inner surface presents the bulliform cells in various forms according to the variety of corn, varying from the wedge shaped, sunken cells to those somewhat exserted and rectangular. Along each side of the bulliform area is often a row of short, spur-like hairs. The function of the bulliform cells is to fold or roll up the leaf. When there is much evaporation the water from these cells is readily given off, and the leaf rolls up, exposing only the outer or lower epidermis, which is thick and smooth, and thus reduces transpiration very materially.

Beneath the bulliform cells is a line of colorless parenchyma. The veinlets or nerves have well developed fibrovascular bundles with areas of stereome or sclerenchyma, both above and below, which connect with the epidermis, and a line of thick-walled chlorophyll parenchyma on each side. The small mestome bundles are numerous, and about every sixth has more or less stereome between it and the epidermis, mostly on the lower or outer side. The other mestome bundles vary somewhat in size according to their proximity to bulliform cells. They are completely surrounded by the thick walled chlorophyll parenchyma sheath, and the mesophyll sheath also, but those connected with the epidermis are only partly surrounded.

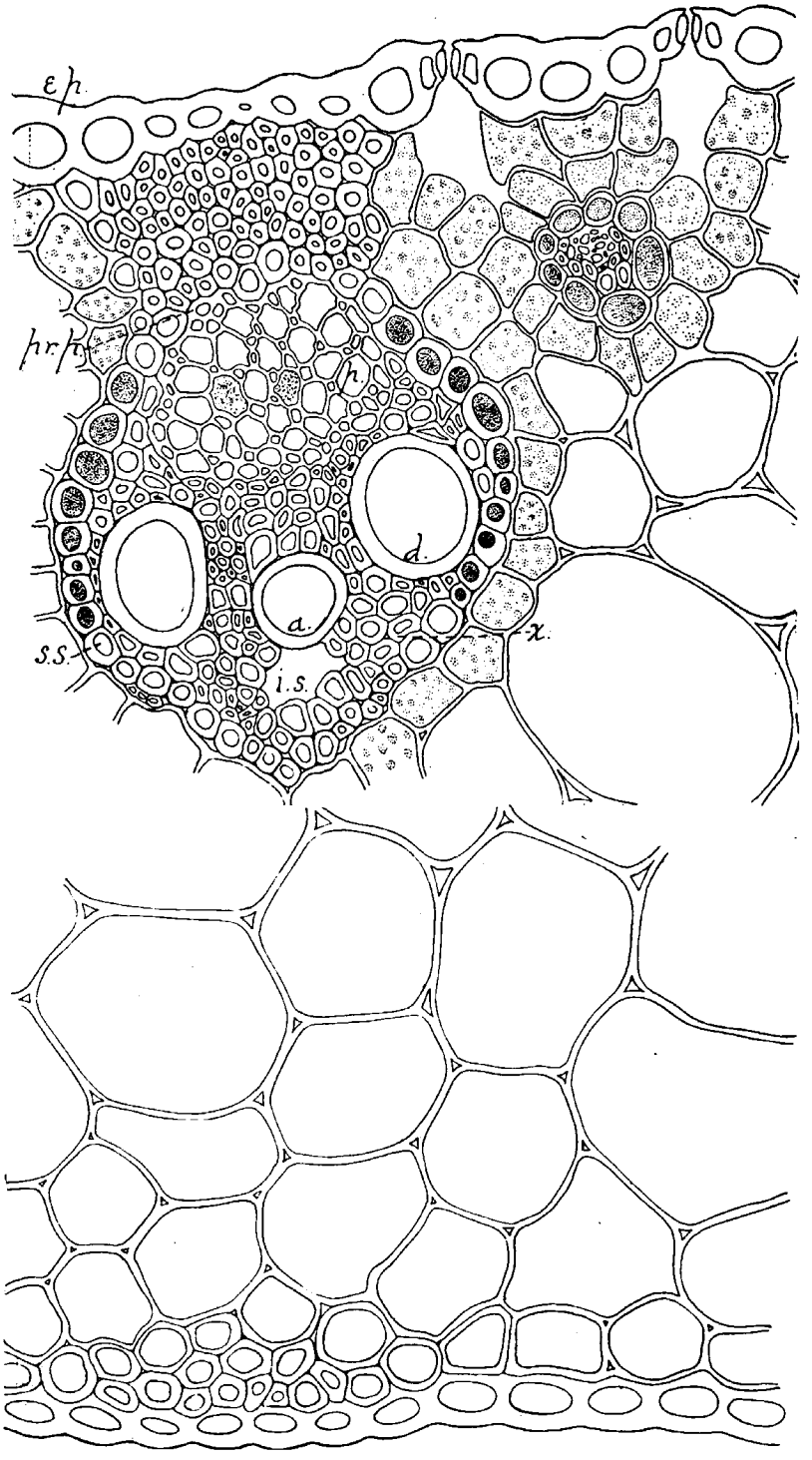
EXPLANATION OF PLATES.

PLATE IX. Cross section of corn leaf sheath showing fibrovascular bundle, the most common, type *ep*, outer or lower epidermis; *st*, stereome; *prp*, protophloem; *p*, phloem, *c. p. s.*, chlorophyll parenchyma sheath; *d*, pitted ducts; *a*, annular ducts; *i. s.*, intercellular space; *s. s.*, sclerotic sheath; *par.*, colorless parenchyma; *i ep.*, inner epidermis.

PLATE X. Cross section of keel showing large fibrovascular bundle with a mestome bundle to the right. (See Fig. 12 for small bundle.) *Ep*, lower epidermis; *prp*, protophloem; *d*, pitted ducts; *a*, annular duct; *i. s.*, intercellular space; *s. s.*, sclerotic sheath; *x*, xylem.

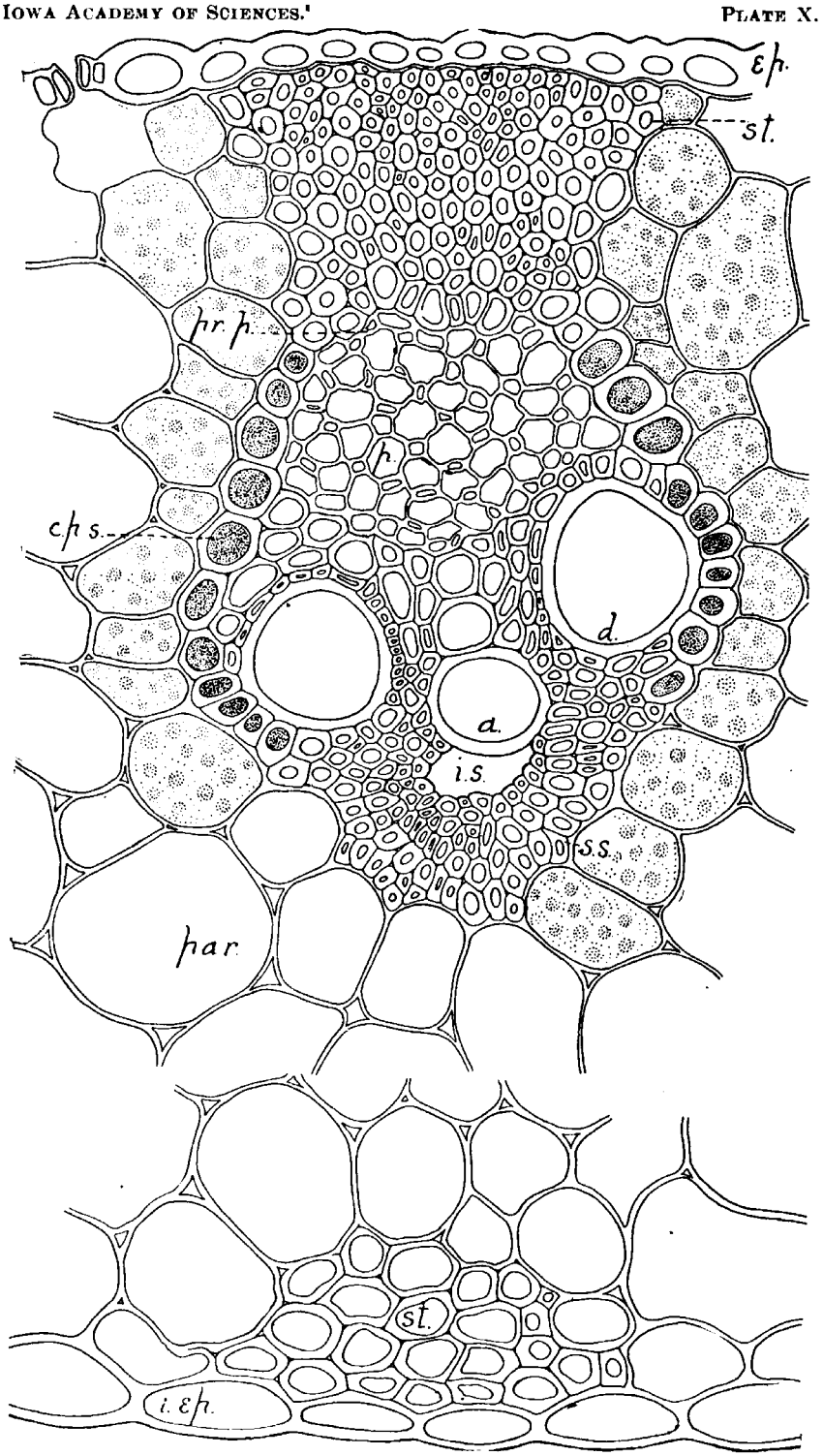
PLATE XI. *Upper fig.* Cross section of the leaf blade of corn. *Ep*, upper epidermis. *b*, bulliform area surrounding the base of a hair; *c. p.*, colorless parenchyma; *s. s.*, sclerotic sheath (chlorophyll bearing) of the mestome bundles; *par*, parenchyma *Lower fig.* Upper surface section of epidermis; *b*, bulliform area; *ep*, epidermal cells; *sto*, stomata.

IOWA ACADEMY OF SCIENCES. PLATE IX.



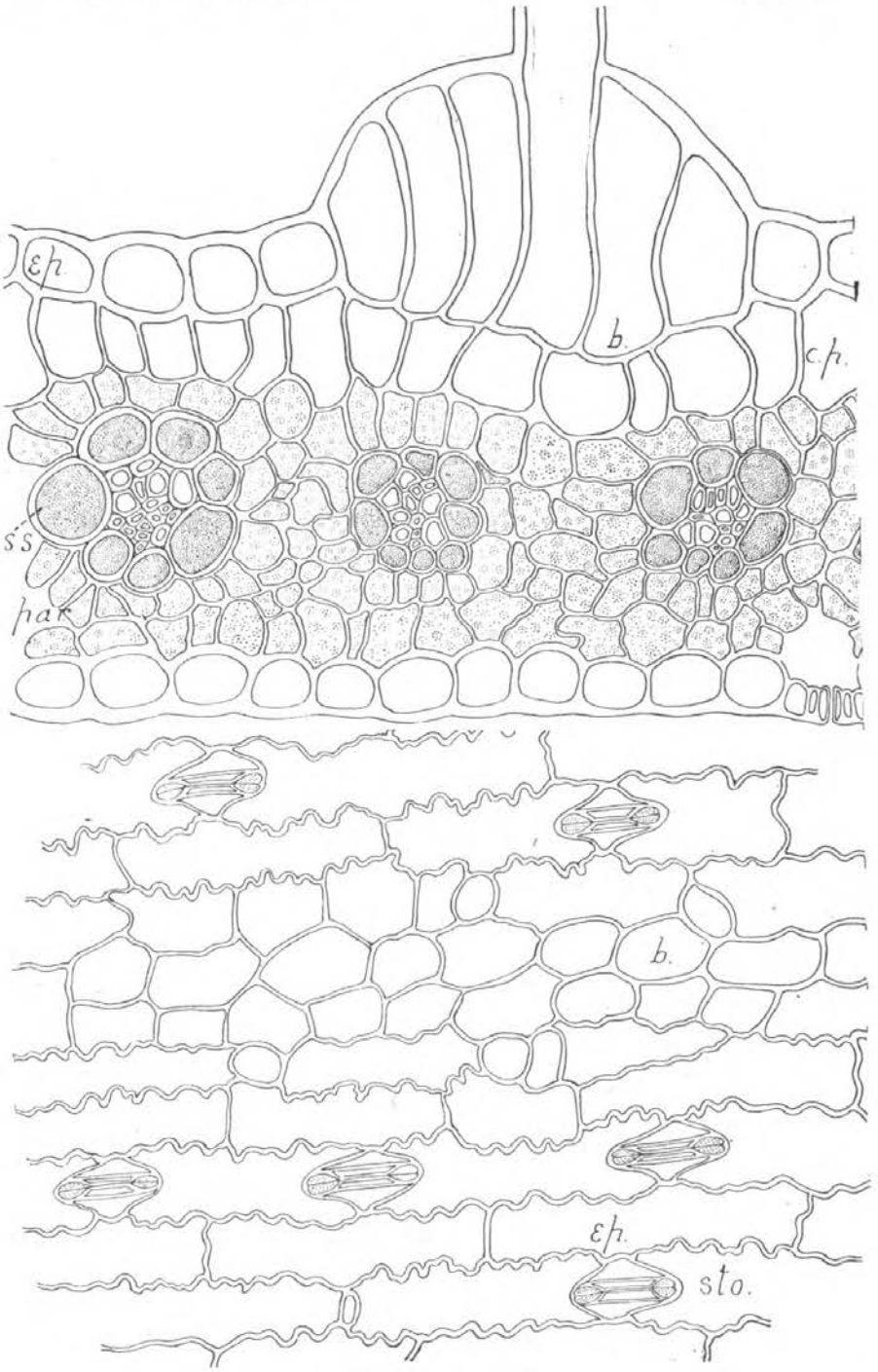
COMBS ON CORN LEAF.

IOWA ACADEMY OF SCIENCES.' PLATE X.



COMBS ON CORN LEAF.

IOWA ACADEMY OF SCIENCES. PLATE XI.



COMBS ON CORN LEAF.