THESIS

ANATOMY OF

FRAGARIA VIRGINICINUS.

by

Effie A. Mathers.
Gross Anatomy

This plant belongs to the Vegetable kingdom series Phænogamae, class Exogynes, sub-class Angiospermous, order Rosacææ, sub-order Pomaceæ (Pear family) genre Fragaria and specific Virginiæ.

The wild strawberry is supposed to have been derived from the white potentilla with which in some places it is still found growing side by side. The chief difference are the wider opening of the strawberry blossom and a reddish or yellowish color visible about the base of the stamen; also that while the receptacle of the strawberry becomes a sweet pulpy enlargement the white potentilla produces only little hard nutlets. These nutlets are very small, dry,
one seeded, and are arranged very closely on the receptacle, which sometimes becomes a little pulpy as it ripens. Through the process of accidental change and selection this pulpy part has increased in importance until we have the strawberry.

Fragaria Virginica is a perennial herb, almost an evergreen, having the leaves radical and compound, with three leaflets. On the first two or three leaves of each plant, it is no uncommon thing to find, midway from the base of the petiole to the first leaflet, two rudimentary leaflets which point directly to the derivation from a plant having leaflets numbering five to each petiole. The petiole is about twice as long as the central leaflet; it is rounded at the back and sides and curved
in at the front part; the surface is covered with silky hairs and has two broad very thin stipules attached laterally to the base of the petiole but sloping to a point on either side. The leaflets are obovate wedge form with coarsely serrate margins, frayed-veined, smooth on the upper side, while the underside is covered with white silky appressed hair. The flower stalk is similar to the petiole rounded, and usually not quite so long as the petiole. The flowers are white cymose, on scapes; they are regularly five parted, having twice as many sepals as petals; the sepals are arranged in two whorls, the outer row is darker green, and narrower than than the inner. The stamens are more than twice as numerous as the petals, and the anther is bis lobed; the pistils are
many having styles deeply lateral; they are situated on the receptacle which enlarges and becomes the fruit. We find the achenia or ovaries of the pistils scattered singly over the surface of the enlarged receptacle. After the falling of the petals the sepals turn up to protect the fruit, the enlarged receptacle becomes red when ripe and has a delicious flavor. The stem is mostly subterranean upon which the scar of the old leaves make a rough uneven appearance. The roots grow from the lower part and run him send out roothile. They are smooth and quiet long.

One of the most noticeable features of this plant is its runners which after the fruit has come to maturity, or a little before, are sent out from the stem. These are very similar to
the petiole, rounded branch bearing stems, which grow very long and slender. At the joints they send down slender roots which sink into the ground, and leaves which extend upward. They are often several jointed and thus the plant spreads more quickly and rapidly than by the aid of its seeds.

**Histology.**

The thick subterranean stem has several outer rows of cork cells which have been pushed out, and are dead; beneath these we find the thinner walled, long flat, cork cells in quite a number of rows. Next to this we find the wood zone composed of wood fibres, parenchyma cells with spiral ducts and tracheides interspersed at irregular intervals. These cells are quite irregular in size and the walls are about
The same thickness as those of the cork cells. The center of the stem, the pith, is made up of parenchyma, whose cells are some five or six times as large as those of the cambium gone, with walls exceedingly thick. The structure of the stem as a whole is excessively irregular. In the wood circle there are found at intervals where the leaves are or have been attached, a great many spiral ducts and pitted tracheides. These pass out into the petiole of the leaf and break the regularity of the structure by turning the vessels to the side, and forming fibro-vascular bundles for the petiole. The most of these vessels are long regular spiral ducts, and are very numerous. The pitted cells are mostly elongated and pointed at the ends; they are so pitted that a side view gives the appearance of walls
thickened at intervals in square.

Root—The epidermis of the root is composed of elongated cylindrical regular cells. represented in Pl. I. Fig. 1 so elongata are found. A transverse section of the root is shown in Pl. III Fig. 2. It is composed of a large fibro-vascular bundle occupying the center of the root, around which is a large mass of parenchyma; at the extreme edge the cells become thickened and form the epidermal layer of the root. The fibro-vascular bundle is composed of four groups of spiral vessels, each of which are surrounded by wood fibers forming a united whole. At the outer part of the bundle is a thickened row of cells called the bundle sheath. Parenchyma surrounds the whole leaving the epidermis upon the surface. Pl. III Fig. 1 represents a rootlet which has the same essential tissue.
as the root but here only one bunch of spiral ducts. Fig. 2. shows only one of the four groups of spiral ducts; this is represented at a, while b is the soft bast tissue, c is the bundle sheath, d the parenchyma and e the epidermis. The longitudinal section shows epidermal cells at the edge then hypodermal and parenchyma following closely; the walls of the parenchyma are much thinner than the hypodermal and epidermal cells. The bast fibers and spirals are found mixed at the center. Plate II. Fig. 1. shows the longitudinal section spoken of above.

Runner. — The runners have an epidermis much like that of the petiole, which is described under the head of petiole and figured in Plate Fig. 1. The cells are a little longer in the runners than those in the petiole and the stomata are about as frequent as are those in the epidermis of the petiole.
A cross section of the runner, represented in Pl. IV, shows pulp composed of parenchyma in the center, the central cells of which are quite large while the others grow smaller to the edge of this pulp, as shown in the Plate IV. Around the pulp is a circle of spiral ducts and fanned cells shown at b. in the figure. Then we have the narrow long wood fibers at c, the soft bast with its walls gradually thickening and then parenchyma, collenchyma and epidermal cells follow in succession as represented by d, e, h, i. A longitudinal section of the same, Plate II fig. 4, shows the cells to be as before represented. The principle thing to be noticed in the runner, is that all the tissues found in the stem are present here, also soft bast tissue. The cells are all long and slender hardly a break being found in the whole length of the spiral.
ducte. The soft bast has very narrow cells, and these are joined at the ends in a slanting manner. The pitted cells are more irregular coming often to a point and having much thickened walls, while the pitted cells are about twice as long as broad, being quite broad in comparison with the others.

Petiole and leafblade — The epidermis of the petiole is composed of somewhat elongated epidermal cells, which are represented on Plate I. Fig. 3. These cells are very perfectly developed; stomata are found scattered among the cells but are not very frequent.

The epidermis of the stipule as represented on Plate I. Fig. 2. is composed of irregular epidermal cells, with a spiral duct showing beneath, which closing to the epidermis when it was separated from the rest of the stipule. There are an abundance of calcium carbonate crystals.
in this stipule, while hairs are found prominently though not very abundantly scattered over the surface. No stomata are found. The cells are not very different from the epidermis of the petiole but are a little smaller. The upper epidermis of the leaf is represented in Plate I Fig. 4. Over the veins of the leaf the cells are somewhat elongated and run nearly in branching directions following the veins and veindote all over the leaf; between the veins are irregular cells. In the Fig. a represents the cells over the veins, b. represents the cells between the veins, and c represents a stoma. The stomata are not very numerous. The epidermis of the underside of the leaf is almost identical with that of the upper side; hav-
ing, however, many stomata and often only one intervening cell between them. In the epidermis
of both sides as epidermic as above the veins contain
cuticular, but, they are found in the irregular cells
between the veins. Plate I fig. 5. shows the epider-
mermis from the under side of the leaf, a representa-
a rudimentary hair, of which an abundance are
found thickly scattered over the entire under surface.
Occasional long silky ones are also found, as
represented at b. A cross section of the petiole
near the base shows the pitted vessels as seen in
the stem and runner. Higher up we have
only the fibro-vascular bundles containing sprial
ducts and bast fibres, a species of pire tissue, with
a bundle sheath around the fibro-vascular bundle.
The greater part of the petiole is made up of paren-
chyma. Plate I fig. 1. shows a section of a cross
section of the petiole, and the different tissues are
represented quite distinctively. The petiole contains
thin, fine-vascular bundle one of which goes to each leaflet. They are all oblong and the central one is the largest and lies closest to the rounded part of the blade. Within are the spirals and around these lie the soft, light tissue with irregular-sized cells. Around this come the parenchymatous tissue which forms the connection between the bundle. The two smaller bundles are placed near the front of the blade, in the projected portions. These bundles are not parallel but inclined toward the largest bundle. In arrangement of tissue they are exactly as the larger bundle. At the very outer edge of the petiole for four or five rows the tissue has very much smaller cells, the collenchyma.

A longitudinal section is represented in Plate II, Fig 2. The outer epidermal cell is a very little thickened next to that we have the collenchyma.
These cells differ but slightly from the epidermic and gradually run into the parenchyma; then comes the soft test which surrounds the spiral where the section goes through the fibro-vascular bundle. A transverse section of the leaf is shown, Plate II Fig 8. The cells of the outer row are thickened a little and are the epidermic, next below at 8 we have the palisade cells, these are square or vertically elongated. Below this at 6 we have the leaf parenchyma and again the thickened epidermal cells on the lower part of the leaf. The palisade and parenchyma cells are densely filled with chlorophyll.

Flower Stalk—The epidermic is the same as that found on the runners and petiole, very long slender cells with blunting joinings at the ends. Stomata are scattered over the surface very sparingly, perhaps.
not quite as many as in the petiole epidemis.

A transverse section of the flower-stalk Pl V Fig. 2 shows the pith a which is loose parenchyma and arranged around the pith are scallops which cut into the parenchyma, are the fibro-vascular bundles. The cells vary in size as do all the others of which we spoke. In an oblong structure of almost equal width as the widest part of the rows of spiral ducts & tracheides c. come the cambium &

Outside in about the same or a little smaller width gone we find the soft bast d. These cells have very thick walls; there is a distinct division between this section and the next as much so that when the section is cut the outer layers drop off. There is a small row of cells probably parenchyma where the section separatethen larger ones which gradually become smaller again and finally come
the hypo- and epidermal cells. In the longitudinal section we find the section almost identical with that of the summer, the same tissues occupying the same relative place.

Flower, 1st Essential organs — The pistile are very numerous, situated on the receptacle, and have three style deeply lateral. One side of the style is tall slender and bears the stigma which is only an irregular mass of small loosely joined cells forming a ragged top. The style is also made up of loose parenchyma cells with small fibro-vascular bundles coming from the ovary, which contain the ovule.

The walls of the ovary are several rows of cells within which is the anatropous ovule with its calaza at the upper pointed end of the ovary. The ovule has an embryo sac near the center of the micellae. The stamens have a filament
similar to the style of the pistil, composed of similar loose parenchyma cells, as is also the anther, only the cells of the latter are much smaller than those of the filament. The anther is two lobed and after delipidation is thickly covered with yellow pollen. The pollen grains of this specimen examined were of two kinds; the same in general shape but differing greatly in size. Their shape is elliptical and they have striations running lengthwise, as the lines of longitude on the Earth. The outer coat is a cuticularized layer called the extirpate and has a clear yellow color. The nitrite or inner part is a clear granular structure. When they begin to germinate they send out a clear tube which enters the stigmatic tissue. The two kinds of pollen clearly indicate that cross-fertilization has occurred.
20th The Periante — The lower or outer epidermis is composed of irregular angular cells, in the petals, with small projections from either side ending in a small dot or knob. These are represented in Plate VI Fig. 4. The upper surface has irregularly six sided cells when looked at from above, their markings indicate them to be pyramidal in shape. These cells are shown in Plate VI Fig. 3. While Fig. 2, gives a side view of the same, showing the real pyramidical shape which gives the surface a peculiar velvety appearance. Between these layers of cells there is another with very thick and very irregular walls; these are represented in Plate VI Fig. 1. There are veins running through the petals from the base upward and branching mostly toward the top. These are found to be composed of small
spiral duct. The irregularity of the whole structure serves to break up the light and thus give a white petal. The outer epidermis of the sepals is the same as that found in the upper part of the leaves, composed of irregular roundish cells seen in Plate I fig 5, with elongated ones over the spiral ducts which constitute the veins. This epidermis has many silky hairs and a few stellate sparsely scattered over the surface. The upper epidermis is the same as that of the under part of the petal, having irregularly angular cells, only not quite so minutely branched. There is chlorophyll within these structures giving the green appearance to the leaves, stem and Fruit. The receptacle becomes enormously developed and pulpy when mature. It is com-
fixed of rounded and oblong cells and many fibro-vascular bundles. In the very young receptacle these cells and bundles seem to have no definite arrangement in relation to each other; but as it becomes a little older, the cells that form the oblong center of the receptacle have cells larger and more elongated than the others.

Around this are regular order more fibro-vascular bundles; and radiating around it all are cells a little more rounded than the center ones and not quite so large; at the outer edge they become still smaller. Grains of starch are noticed quite abundantly all through. As the receptacle enlarges the cells become longer and more numerous. The fibro-vascular bundles extend from the border they form around the center, to each seed.
which forms on the outer part of the receptacle.
When ripe the pulpy mass of cells assumes a light crimson and becomes soft and palatable.