ELEMENTARY SCIENCE BULLETIN NO. 9

April, 1903.

MICHIGAN

STATE AGRICULTURAL COLLEGE

BOTANICAL DEPARTMENT.

A STUDY OF PLANT LEAVES

DESIGNED AND WRITTEN BY W. J. BEAL;

THE ILLUSTRATIONS ALL FROM NATURE BY B. O. LONGYEAR.

AGRICULTURAL COLLEGE, MICHIGAN.

1903

This is the ninth of a series of bulletins on elementary science, published at the Agricultural College. While they are prepared especially with the view of helping teachers and pupils in the common schools, they should interest every enterprising farmer and horticulturist, or any other wide awake citizen. Inquiries for bulletins or for information regarding this work should be addressed to

THE SECRETARY,
Agricultural College, Mich.

The following bulletins of this series have been published :

1. *Observing and Comparing Beans and Peas Before and After Sprouting.*

2. *A Study of Wheat and of Buckwheat Before and After Sprouting.*

3. *A Study of the Seeds of Timothy and of Red Clover Before and After Sprouting.*

4. *Observations on the Leaves of Clovers at Different Times of Day.*

5. *Branches of Sugar Maple and of Beech as Seen in Winter.*

6. *Potatoes, Rutabagas and Onions.*

7. *Convention of Michigan Trees Each to be Personified by a Girl or a Boy.*

8. *A Second Convention of Michigan Trees each to be Personified by a Girl or a Boy.*

9. *The present bulletin is not for free distribution but for the use of beginners in botany at the Agricultural College.*

A STUDY OF PLANT LEAVES.

It would be difficult to find in any of the schools of Michigan a child who does not know that a maple tree, a lilac-bush, or a pea-vine, is well covered with green leaves during the summer. Children very soon learn to distinguish many of the differences in leaves, but they cannot be expected to have any very definite knowledge of the subject until they have studied leaves under the guidance of a well-informed teacher.

The object of this bulletin is to give the pupil a clearer understanding of the forms of leaves of plants. As in the use of former bulletins of this series, so in this, the teacher will by all means first encourage the pupils to bring in as many kind of leaves as they can find, taking pains to gather them while still attached to stems and branches, that their relative positions may be discovered. Most pupils will be able to find out that all the buds grow just above where leaves join the stem, sometimes a little to the right, or to the left, or a few may be found, one at the upper end of each branch.

Illustrations of leaves of some of our common plants are here shown. Accompanying each are given the names of the different parts of the leaf and also the plant to which it belongs.

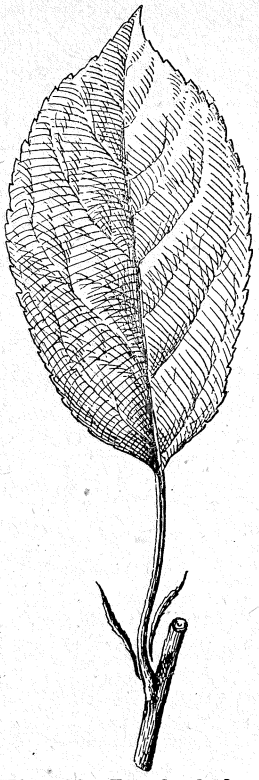


Fig. 62. Leaf of the common apple tree.

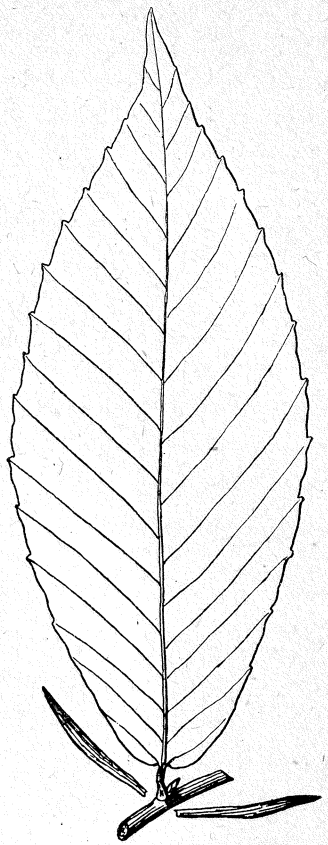


Fig. 63. Leaf of the common beech.

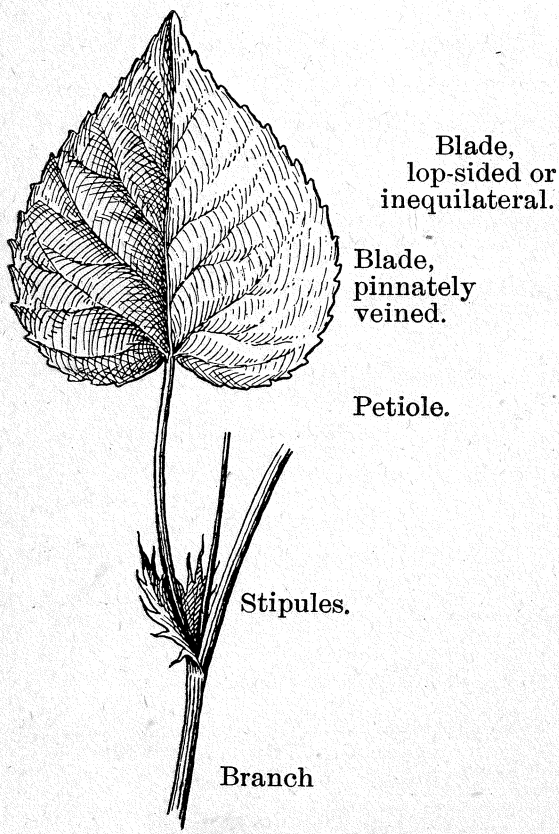


Fig. 64. Leaf of violet.

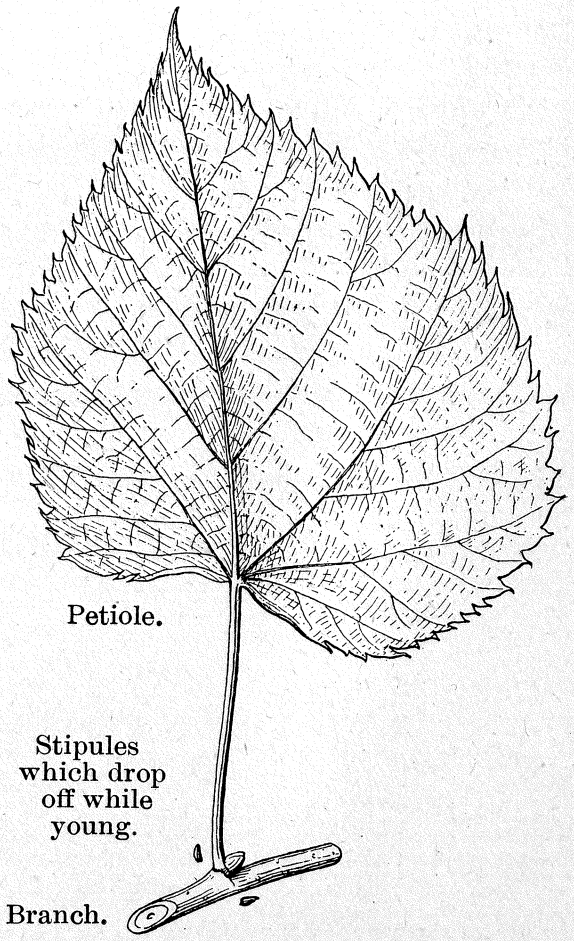


Fig 65. Leaf of basswood.

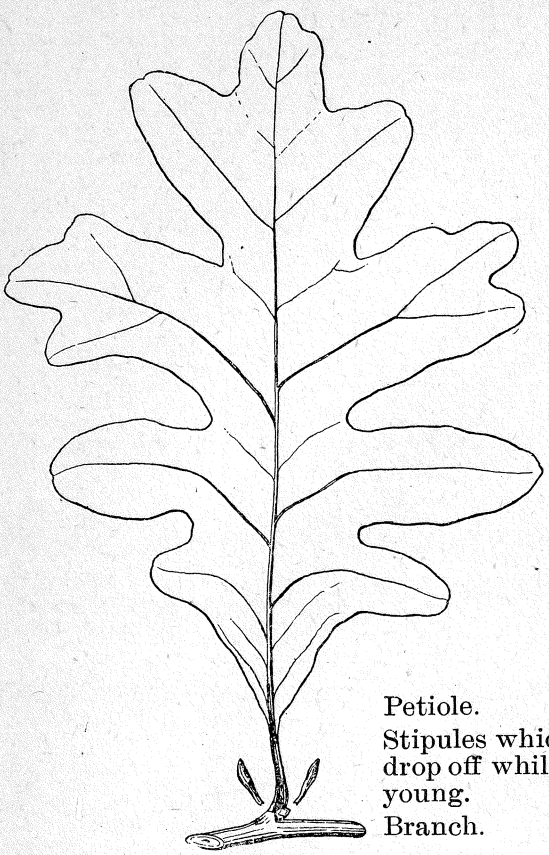


Fig. 66. Leaf of white oak.

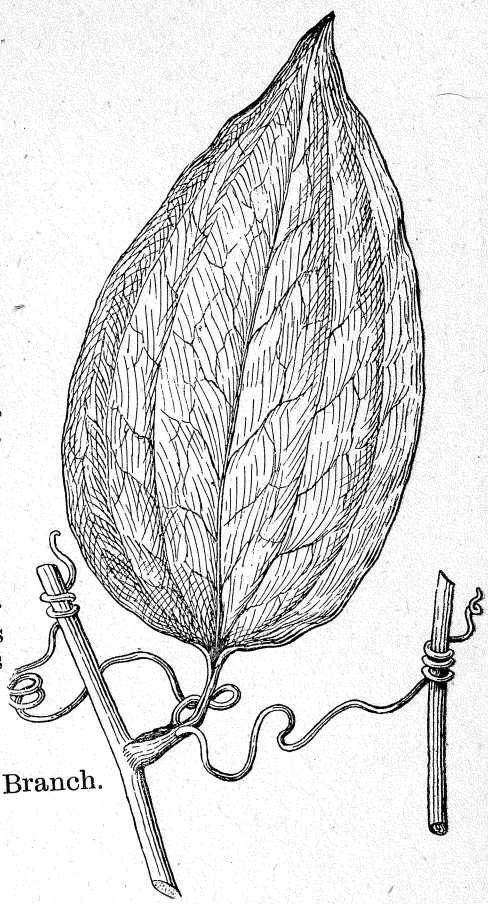


Fig. 67. Leaf of smilax.

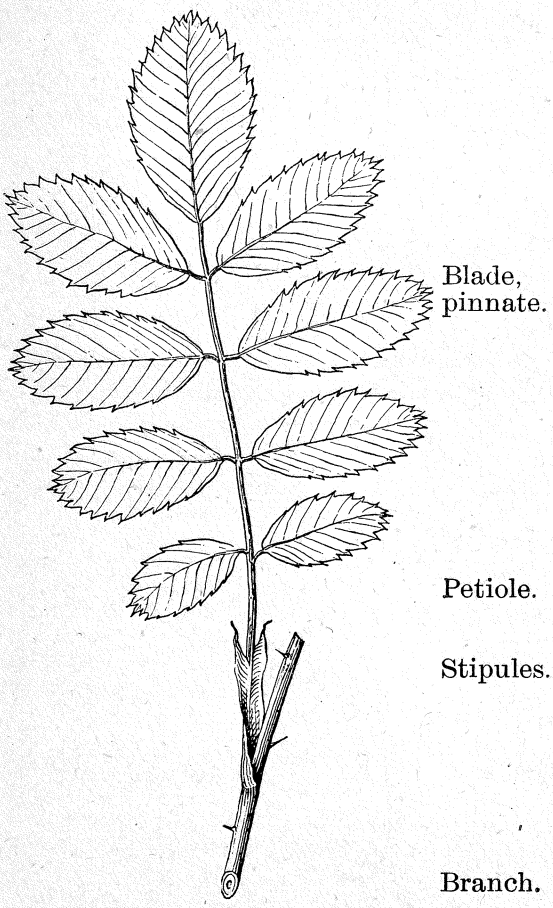


Fig. 68. Leaf of a wild rose.

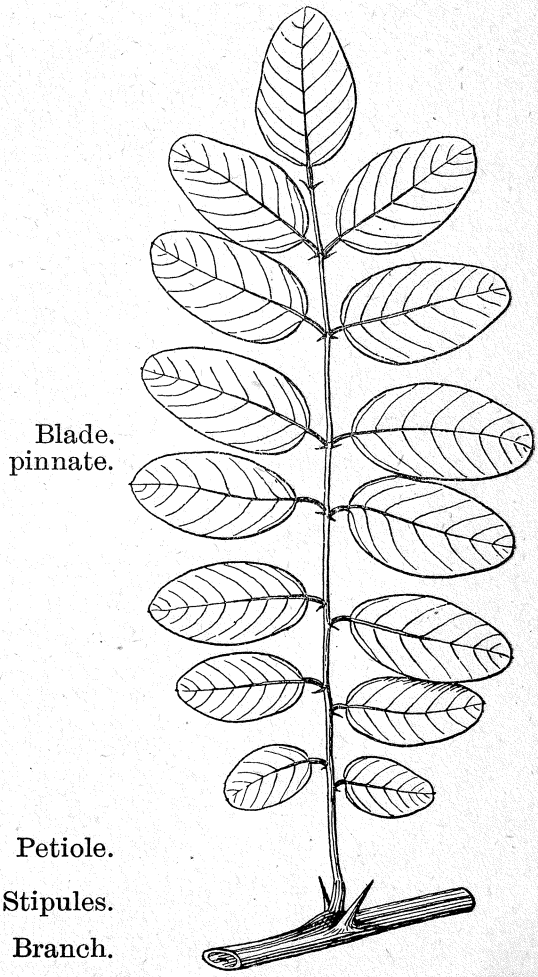


Fig. 69. Leaf of the common locust.

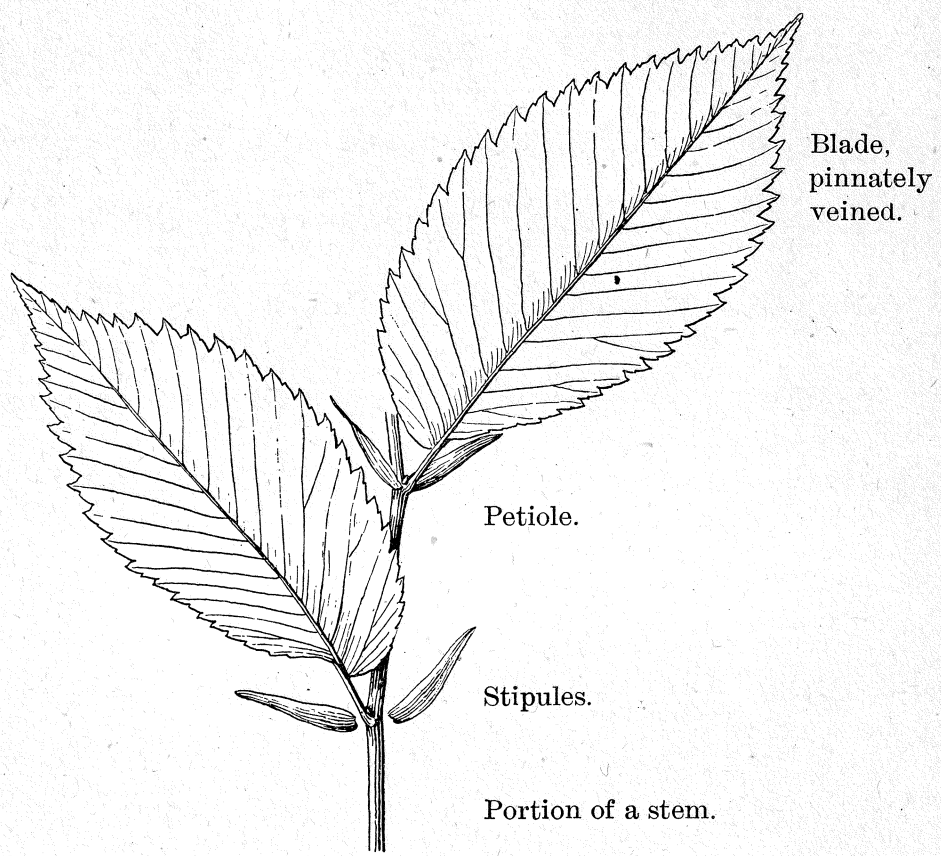


Fig. 70. Portion of a branch of the American elm bearing two leaves that are inequilateral or lop-sided, each having the fuller lobe on the inside next the branch.

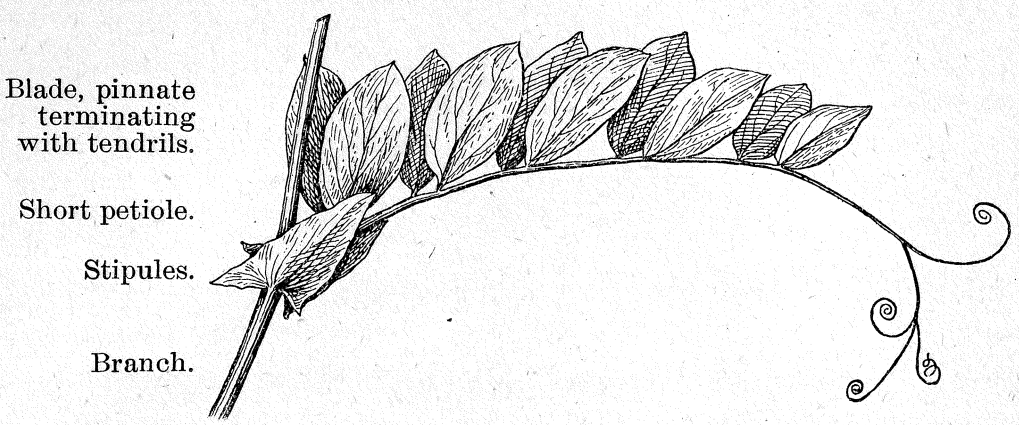
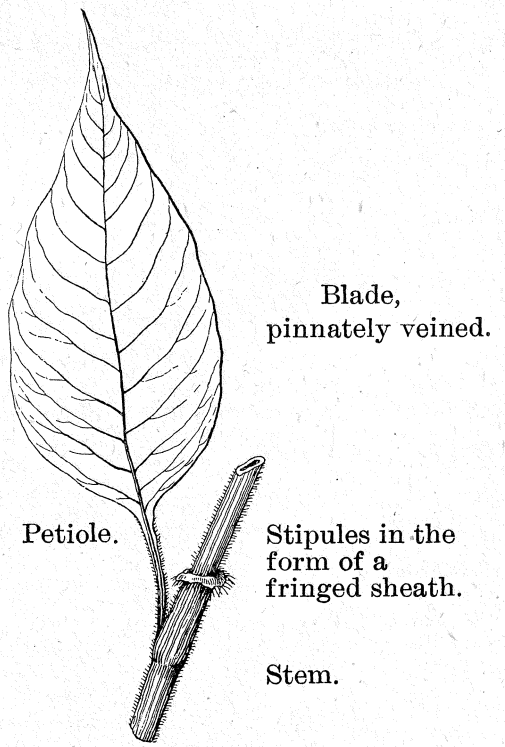


Fig. 71. Leaf of the beach pea.



Fig, 72, Leaf of prince's feather.

All the leaves mentioned above are represented as attached each to a small branch. At the lower end of each of these may be seen a pair of stipules consisting of little scales, prickles, small green objects, tendrils, a fringed sheath or something of the kind; and between each pair of stipules is a short leaf stalk or petiole, which bears a blade consisting of one or more flattened pieces. Such leaves as these are known as complete leaves and consist of stipules, petiole and blade. Study each patiently. See how these differ and yet how they resemble one another, and remember the names applied to them. Look about and try to find leaves of other plants that have all these parts.

In summer, fall or winter, it is not likely that any one can find a leaf of basswood, apple tree, oak, or beech that has stipules, but if the student were to examine tiny leaves of these plants as they were coming out in spring, they would find the stipules which later drop off.

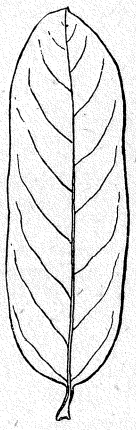
Of course they will always look for small scars left by the stipules. In leaves here illustrated, where the stipules had dropped off, they are represented in the cuts near where they originally grew.

The blades of the leaves of the rose, locust and beach-pea consist of several small, separate pieces, the leaflets. Such leaves are compound. In all except one of the leaves shown above, the petiole continues right on through the middle of the blade. This extension through the leaf is called the mid-rib.

Next following with numbers 73-87, are illustrations showing the general outlines of leaf-blades as far as they can be described by a single word. Leaves thus described are few in number. Almost all leaves need a combination of two, three, or more words for the purpose of description.

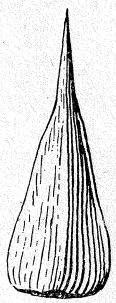
Linear, four or more times longer than wide and with the sides paralel.

Fig 73. Leaf of ground hemlock.



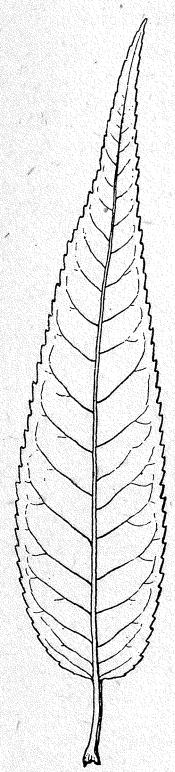
Oblong, two or three times as long as wide and with the sides parallel.

Fig. 74. Leaf of fly-honeysuckle.



Awl shaped, (subulate) narrow and short with a rigid point.

Fig. 75. Leaf of Russian thistle.

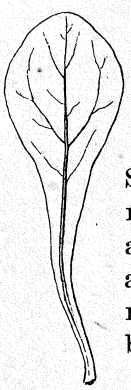


Lanceolate, narrow and tapering gradually upward to a point.

Fig. 76. Leaf of a willow.

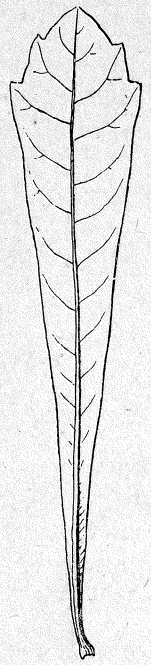
Oblanceolate, narrow and tapering gradually downward to a point.

Fig. 77. Leaf of a fleabane.



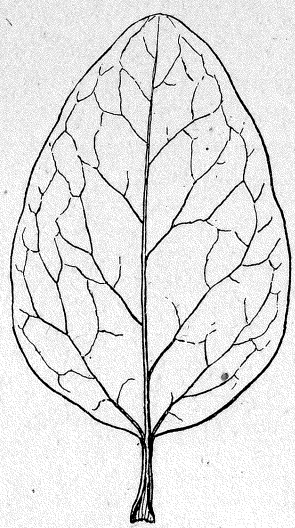
Spatulate, rounded above, and abruptly narrowing below.

Fig. 78. Leaf of water starwort.



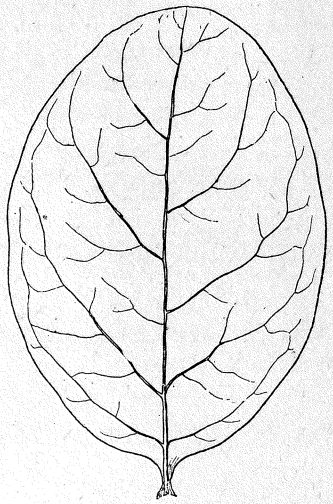
Wedge-shaped (cuneate), broad above and tapering by straight lines to an acute base.

Fig. 79 Leaf of bayberry.



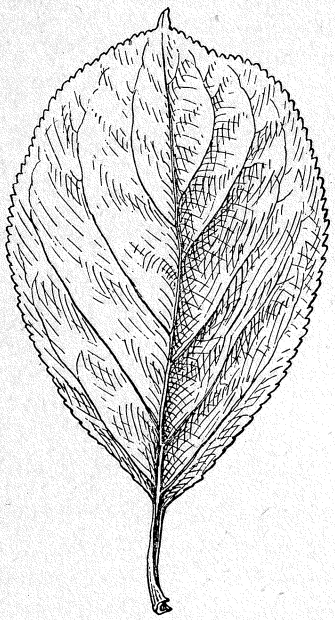
Ovate, the shape of a hen's egg cut through the middle lengthwise, and stem at the broad end.

Fig. 80. Leaf of Japan honeysuckle.



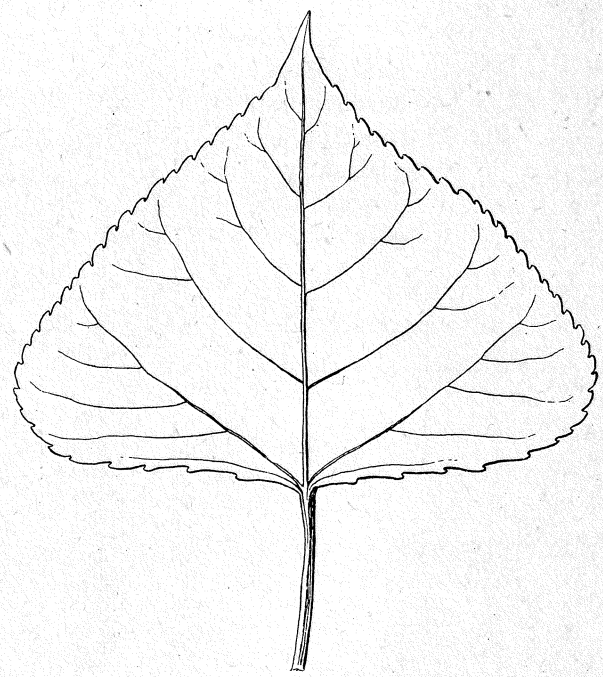
Oval, the width about two-thirds the length and both ends rounded much alike; broadly elliptical.

Fig. 82. Leaf of a honeysuckle.



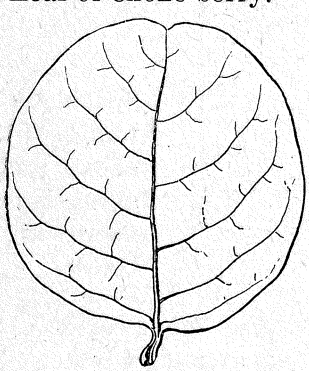
Obovate, the shape of a hen's egg cut lengthwise and the stem at the narrow end.

Fig. 81. Leaf of choke berry.



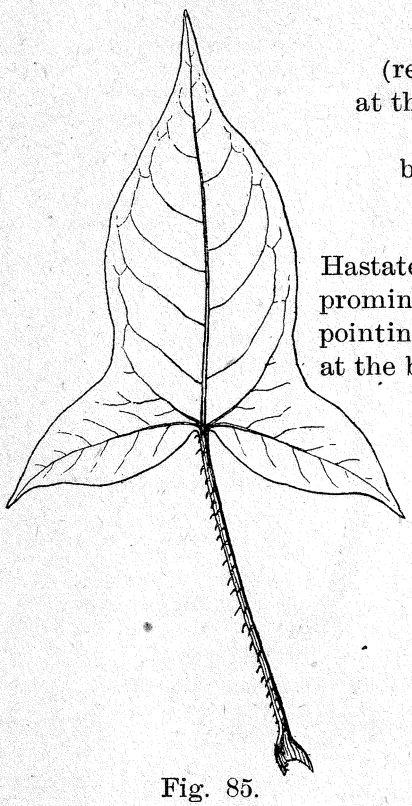
Deltoid, triangular in outline or nearly so.

Fig. 84. Leaf of the cottonwood.



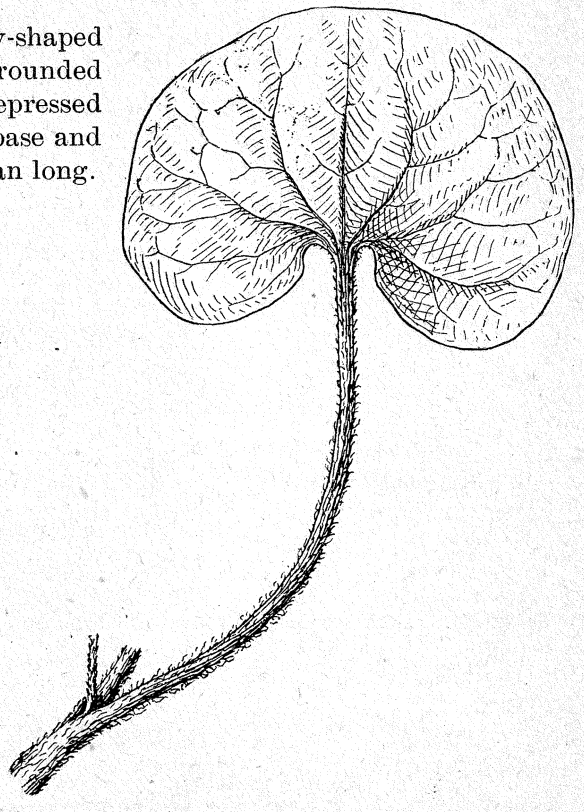
Orbicular, circular in outline or nearly so.

Fig. 83. Leaf of a honeysuckle.



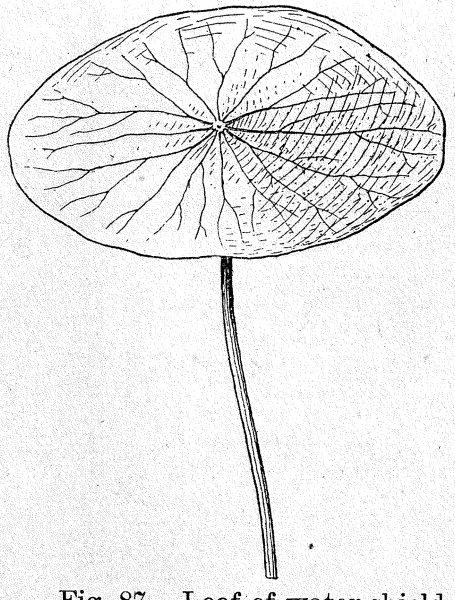
Hastate, having prominent lobes pointing outward at the base.

Fig. 85.
Leaf of halberd-leaved tear thumb.



Kidney-shaped (reniform), rounded at the apex, depressed at the base and broader than long.

Fig. 86. Leaf of wild ginger.



Shield-shaped (peltate), having the petiole attached to the lower surface at a considerable distance from the edge.

Fig. 87. Leaf of water-shield.

Besides the terms employed to describe the general outlines of leaves, there are many others for defining the shape of the base, apex and margin.

Below appear cuts of five other complete leaves, each consisting of stipules, petiole and blade; and a sixth is destitute of stipules.

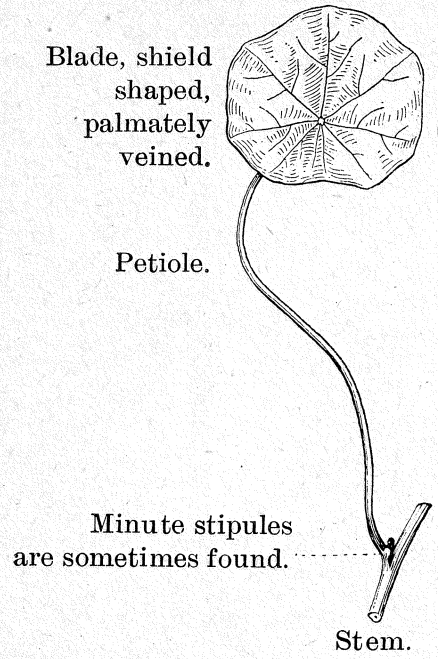


Fig. 88. Leaf of nasturtium.

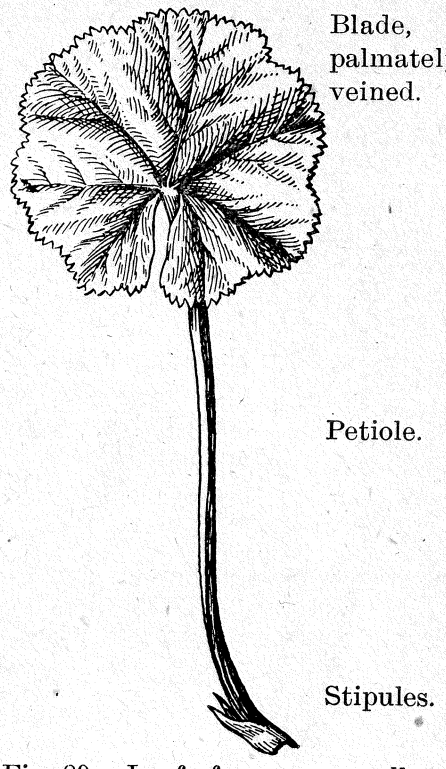


Fig. 89. Leaf of common mallow.

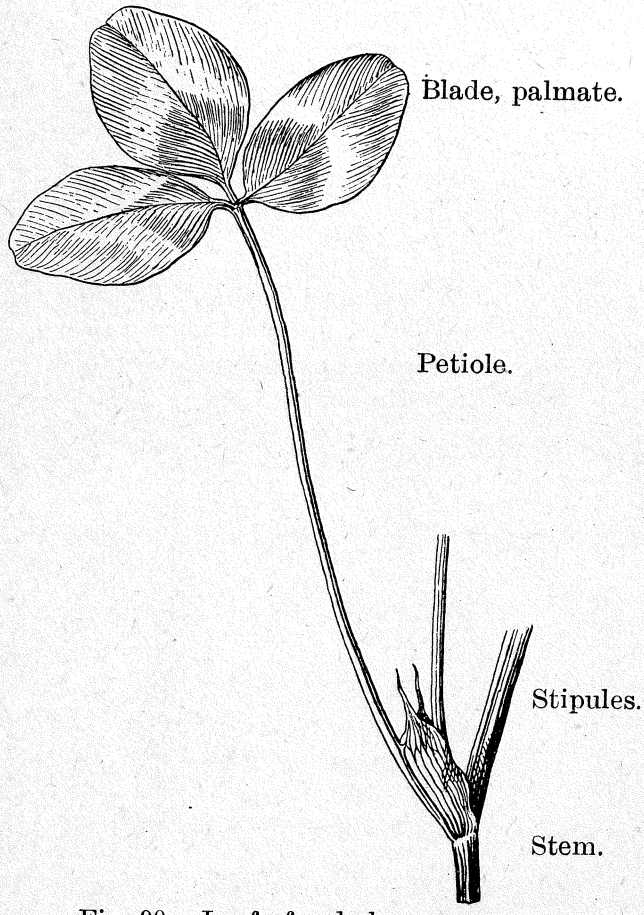


Fig. 90. Leaf of red clover.

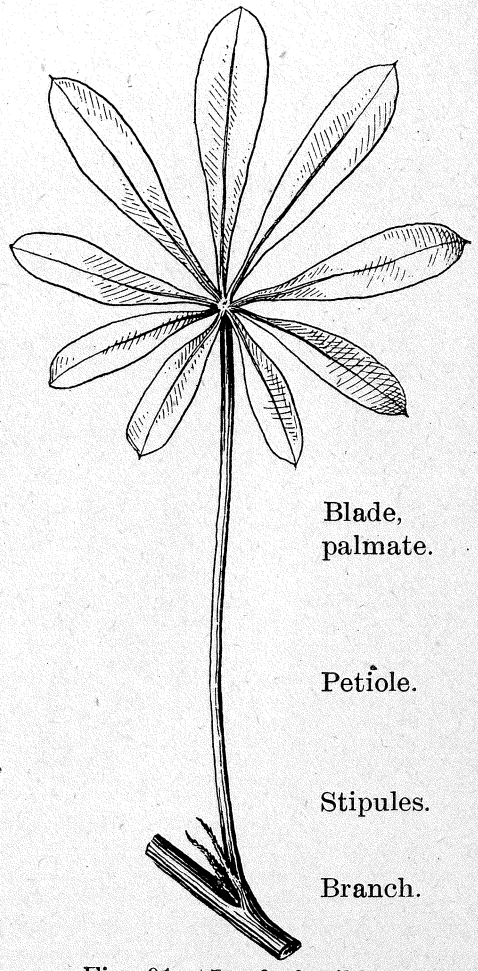


Fig. 91. Leaf of wild lupine.

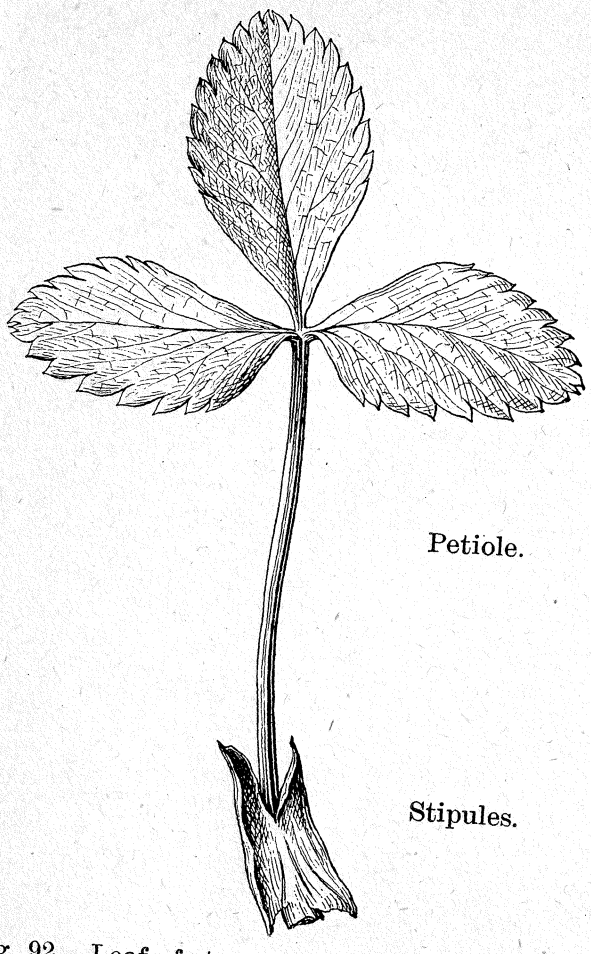


Fig. 92. Leaf of strawberry.

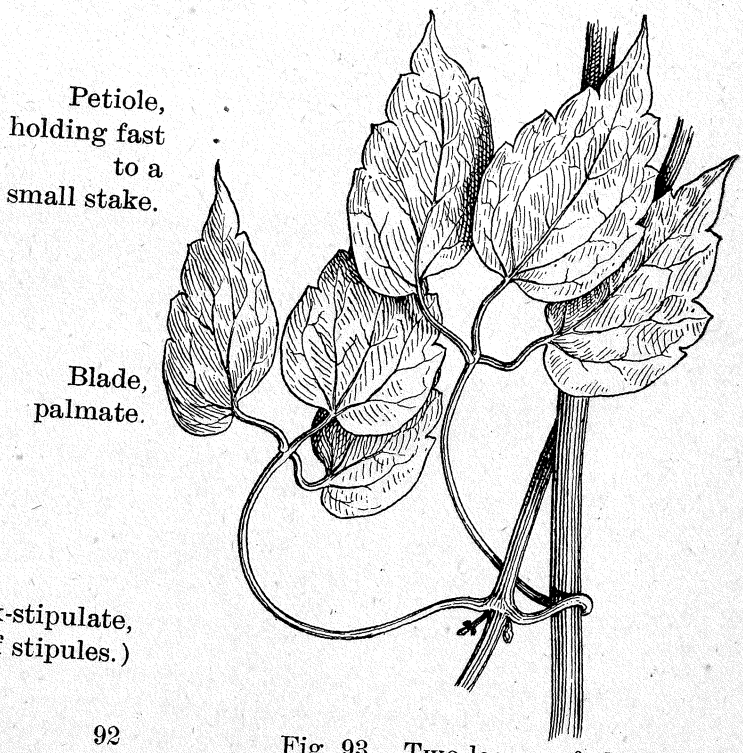


Fig. 93. Two leaves of clematis.

[The above cut is printed wrong side up.]

Compare the six leaves last mentioned with those previously illustrated. Here the petiole seems to stop where the lower end of each leaflet begins.

At the first opportunity, let each pupil try to find leaves with similar structure, and in this way he will become an investigator.

Below are representations of two other leaves:—

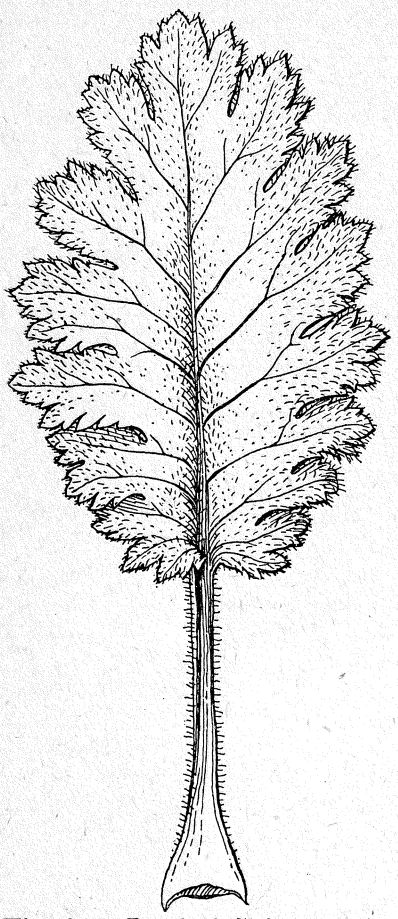


Fig. 94. Leaf of Chinese primrose.

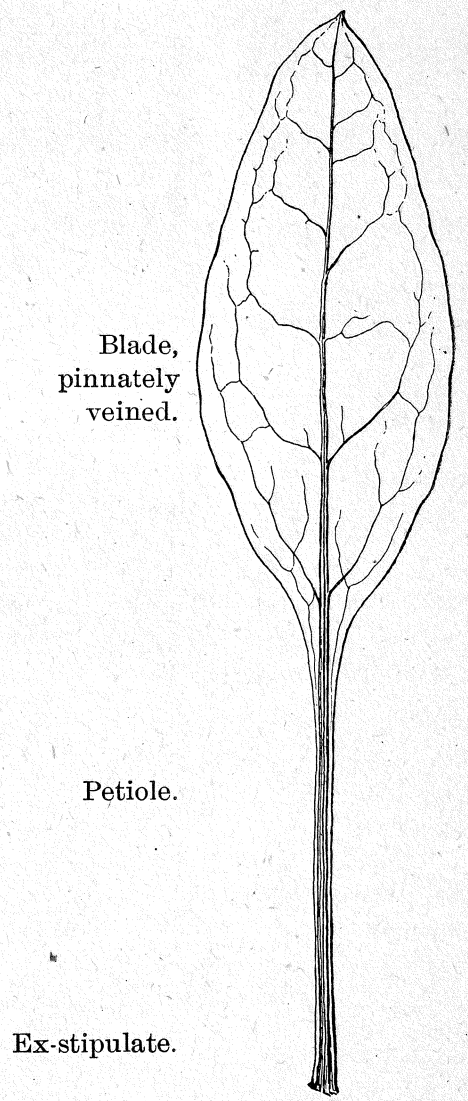


Fig. 95. Leaf of wild comfrey.

Evidently each of these has petiole and blade, appearing like leaves of the apple and the beech, but neither has stipules nor are there any scars where stipules have dropped off.

Next are shown two palmately lobed leaves

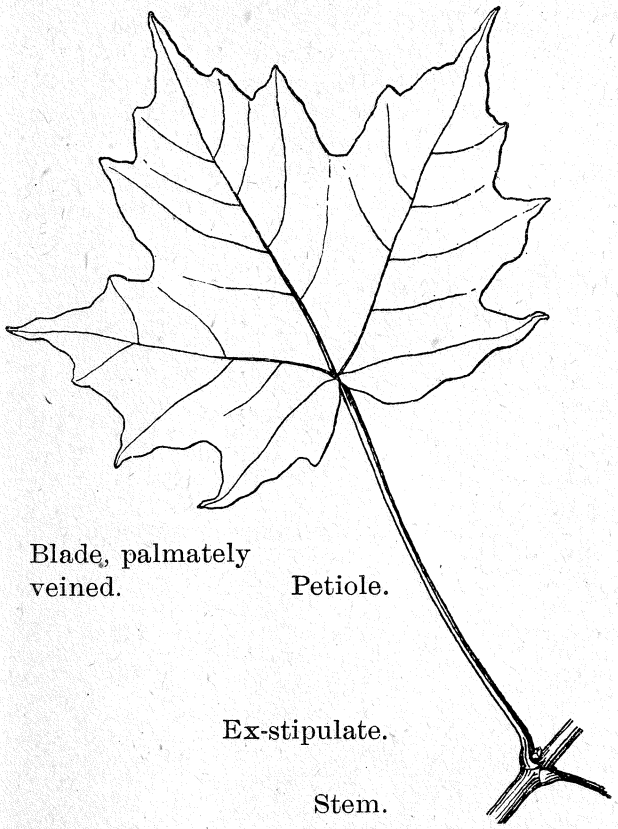


Fig. 96. Leaf of sugar maple.

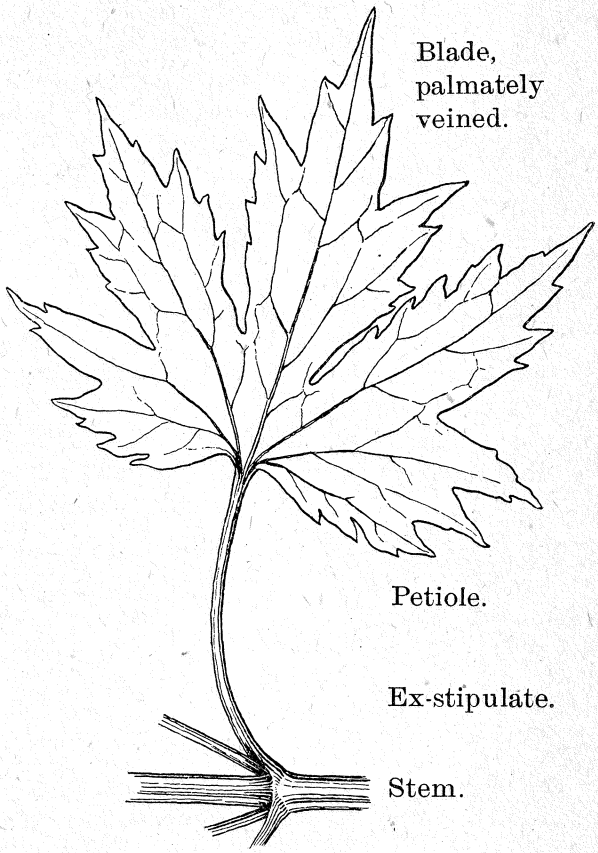


Fig. 97. Leaf of motherwort.

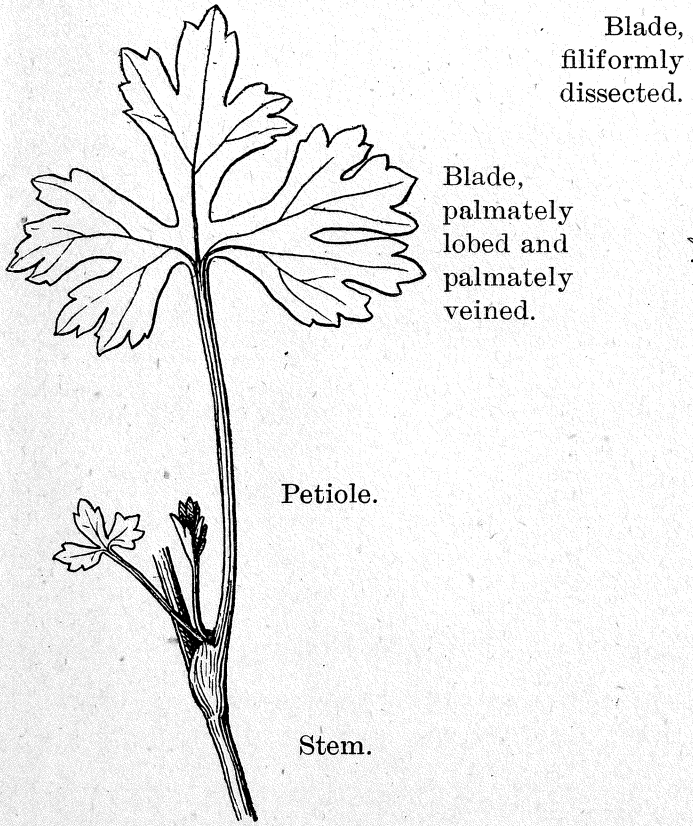


Fig. 98. Leaf of yellow water crowfoot grown above water. These two forms of leaves are produced by the same plant.

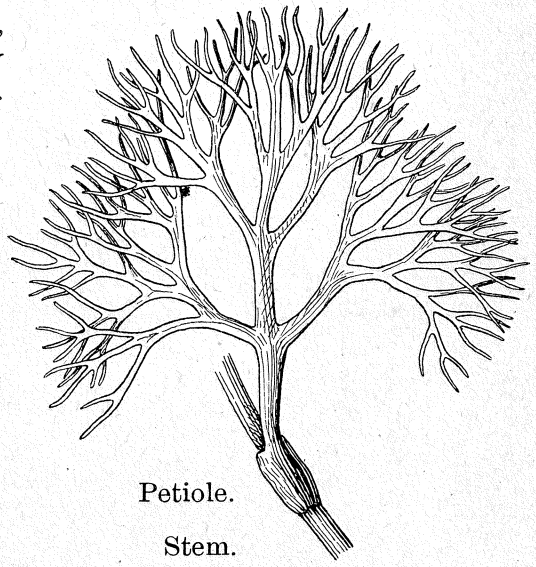


Fig. 99. Leaf of yellow water crowfoot grown in water.

Next appear illustrations of leaves differing from any before mentioned:

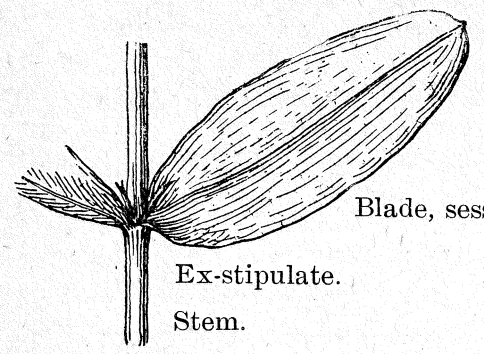


Fig. 100. Leaf of St. John's-wort

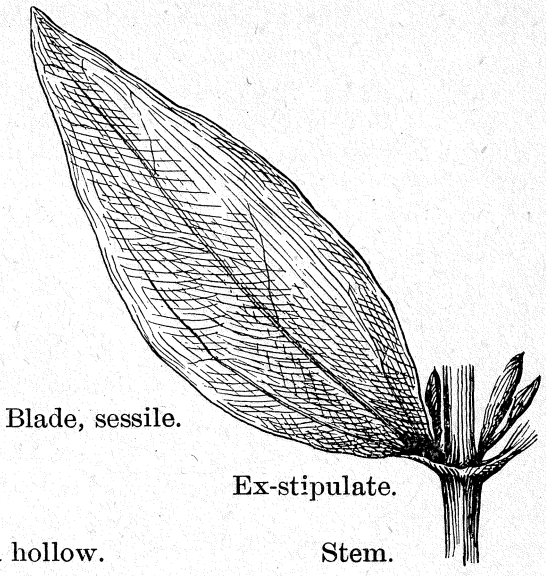


Fig. 101. Bouncing bet. soapwort.

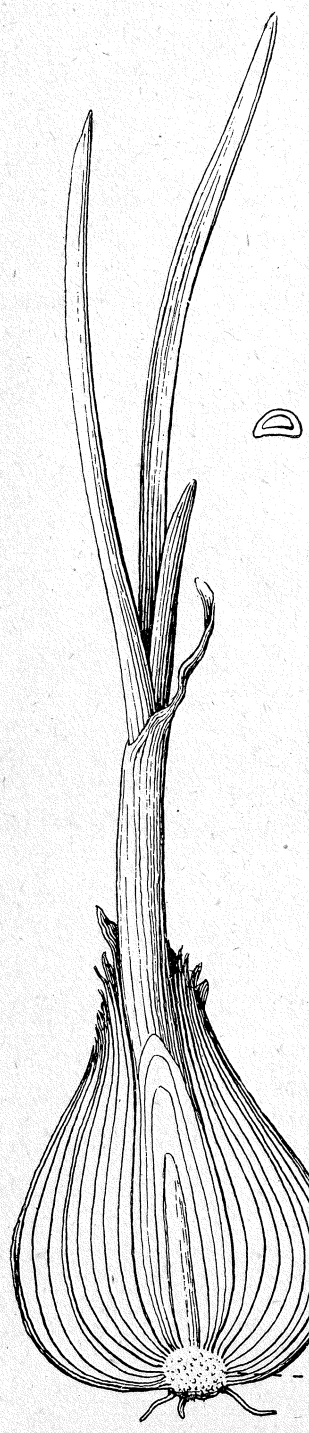


Fig. 102. Leaves of a small onion.

In the Figs. 100, 101, 102, leaves last above, there are no traces of stipules, nor have they any petioles.

Again the pupils are urged to search diligently for leaves, and they will be sure to find some which should be properly placed in this list. Emerson said, "A person finds what he looks for," though he will find many things for which he was not looking.

Having seen a number of forms of leaves by this time, possibly some bright, thoughtful and observing student has wondered whether it is possible to find leaves which contain a petiole or stipules or both without any blade. A few such can be found, but none to my knowledge are natives of Michigan. A great many kinds of trees known as acacias grow in Australia and they bear pods considerably like those of peas and beans. The flat green leaves of these trees are rather hard and naturally turn one edge to the sky, instead of one side, after the manner of most other leaves. The stipules are often present when the leaf is young, but soon drop off leaving scars. Seedlings and quick growing branches produce blades that are compound, but older branches produce flattened petioles. (Phyllodia.)

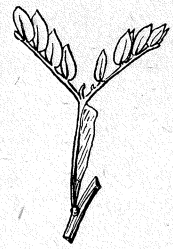


Fig. 103.
Leaf of Acacia.

Fig. 104.
Leaf of Acacia.

Fig. 105. Leaf of Acacia.

The pupils have discovered that no two of these leaves are exactly alike, nor are any two of any one plant exactly alike. They may have observed that all the leaves so far illustrated contain what seems to be a frame-work or skeleton of ribs and veins which run into each other (not over and under like threads in woven cloth), forming a complicated network. All such leaves are net-veined. Are these ribs and veins any more prominent on one side of the leaf than on the other side?

Before reading the text concerning the following figures, students should be asked to examine carefully the leaves of a grass, such as timothy, wheat, oats, rye, Indian corn; Solomon's seal, lily of the valley, Spanish bayonet, a palm.

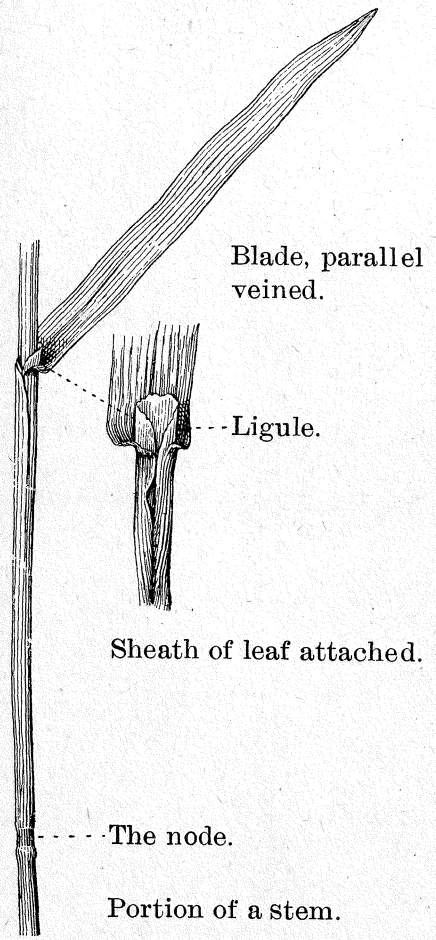


Fig. 106. Leaf of sweet vernal grass.

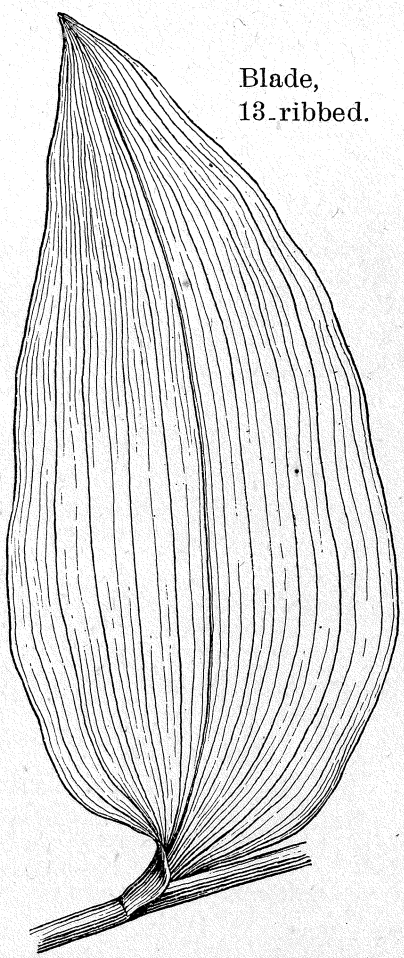


Fig. 107. Leaf of Solomon's seal.

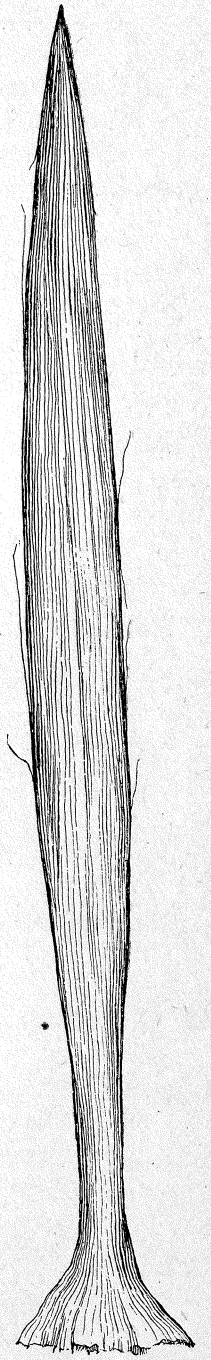


Fig. 108. Leaf of Spanish bayonet (Yucca); the base widened, sessile, ex-stipulate, parallel veined.

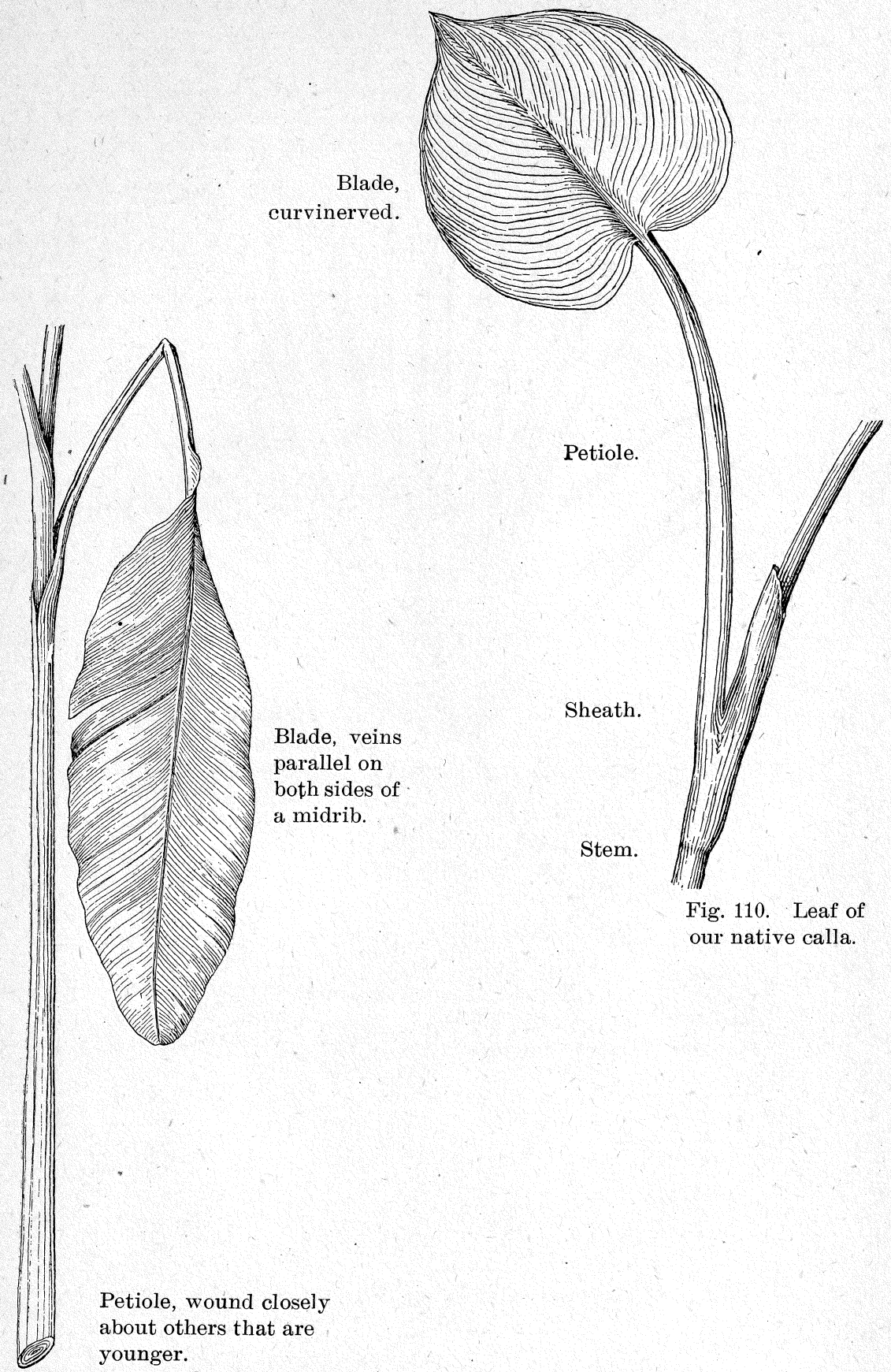


Fig. 110. Leaf of our native calla.

Fig. 109. Leaf of a very small plant of banana.

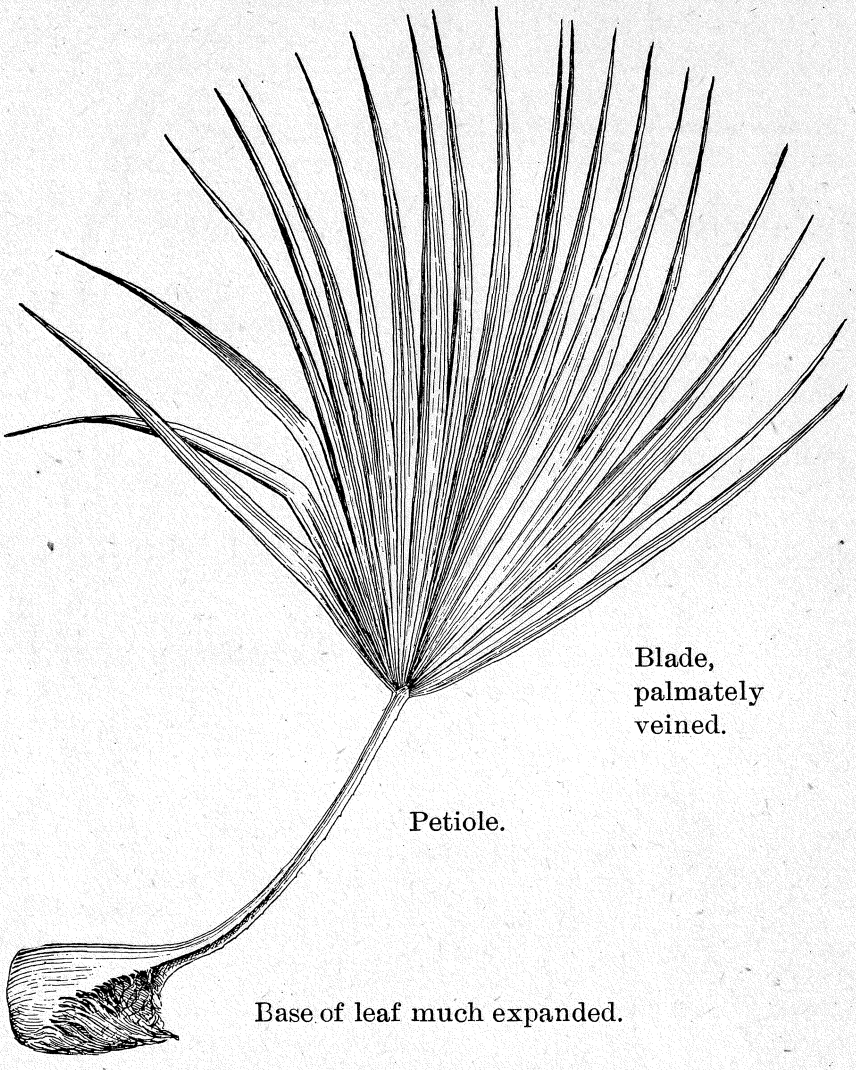


Fig. 111. Leaf of a fan palm.

The veins or nerves of the grass, lily-of-the-valley, Yucca are nearly parallel and have no conspicuous short veins crossing or connecting any two of the prominent veins. In leaves of calla and palm there are some obscure cross veins.

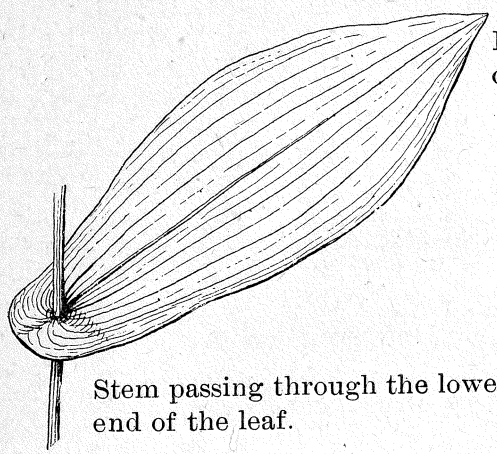


Fig. 112. Leaf of bellwort.

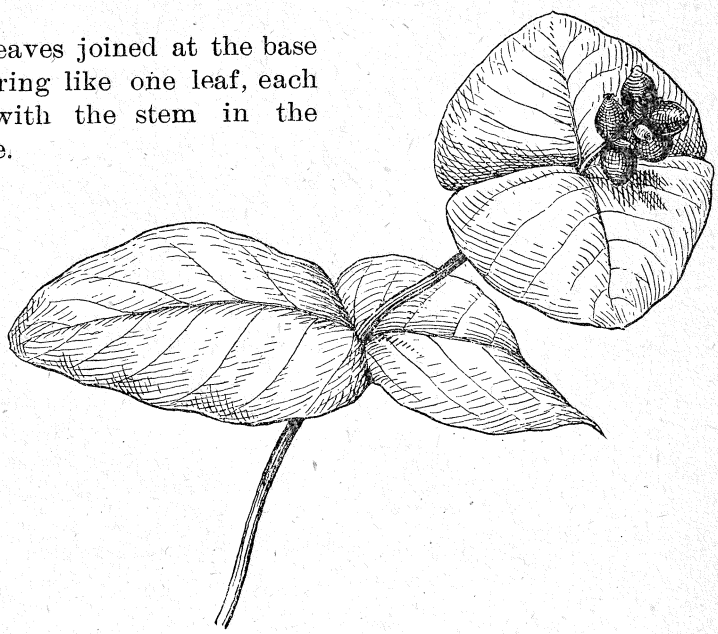


Fig. 113. A small branch of honeysuckle bearing leaves.

Some leaf puzzles are next shown for the young folks to work out if they can.

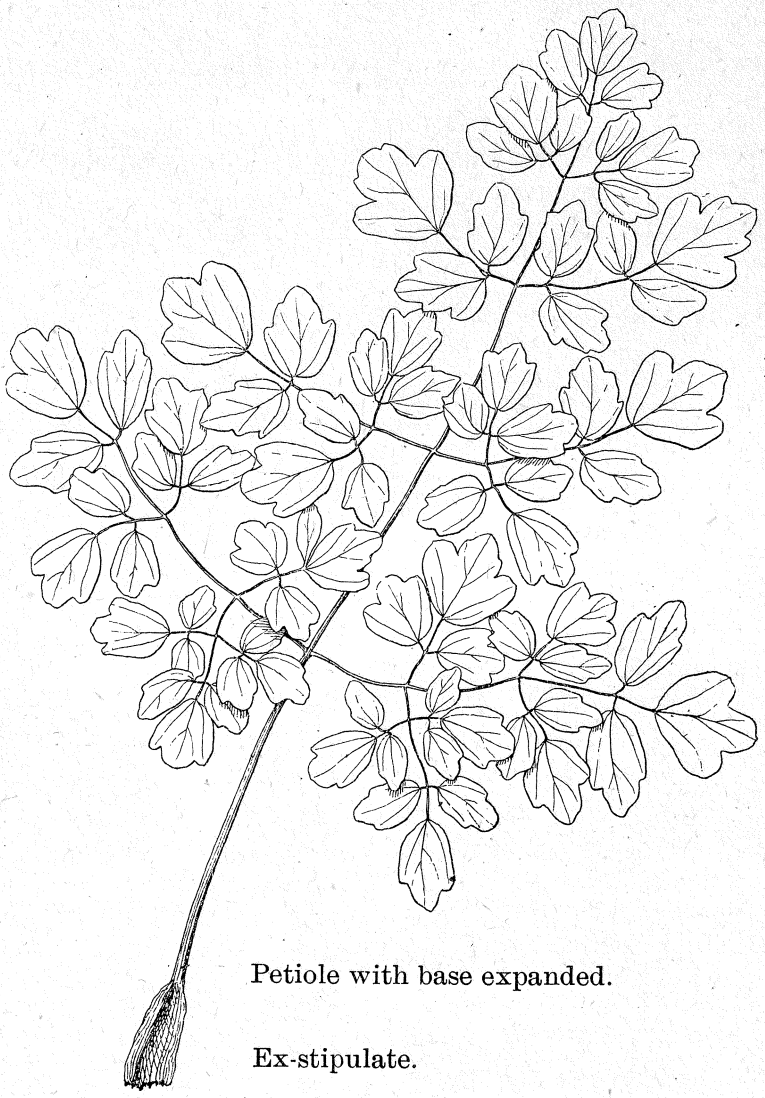


Fig. 114. Compound leaf of a common meadow rue.

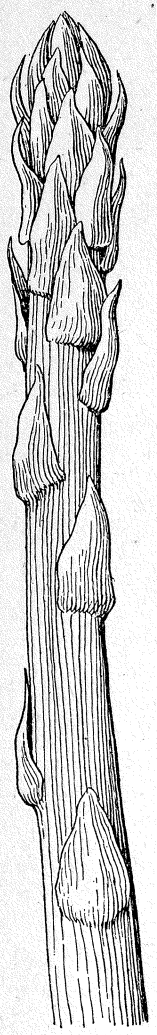


Fig. 115. Young stem and short leaves of asparagus.

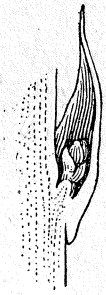
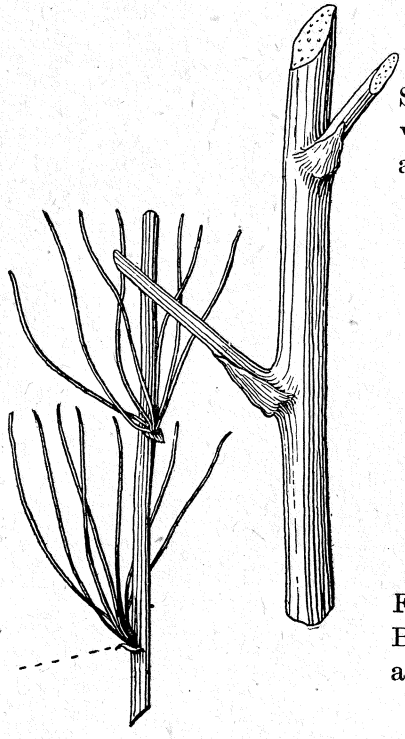


Fig. 116. Portion of a leaf removed showing a bud above.



Scale-like leaf with a branch above it.

Small scale-like leaf, above which are several narrow thread-like green branches.

Fig. 117. Branch of asparagus.

Fig. 118. A small upper branch of asparagus.

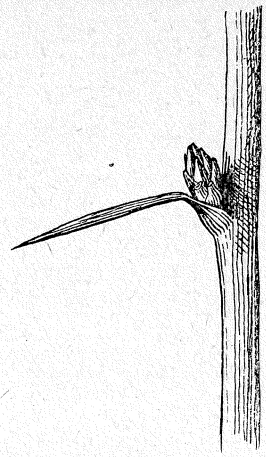


Fig. 119. A small leaf of the barberry in the form of a spine above which is a very short bud-like stub of a branch.

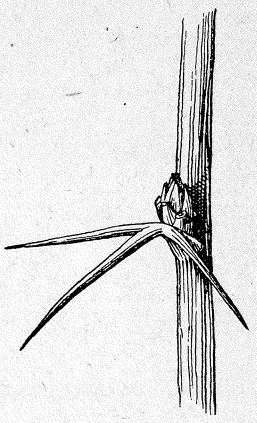
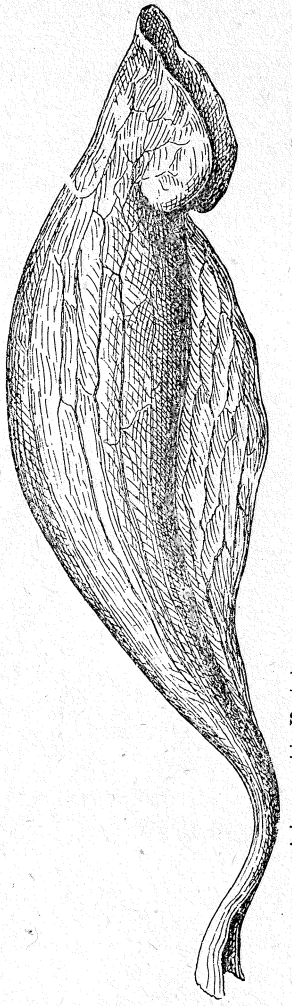


Fig. 120. Three-pronged spine of the barberry with a very short branch above it.

Fig. 121. Three-pronged spine with a very short branch above it, bearing leaves as seen in summer.



Blade.

Petiole, (phyllodium), hollow and used to catch small insects and worms for food.

Ex-stipulate.

Fig. 122. Leaf of a pitcher plant, found in swamps.

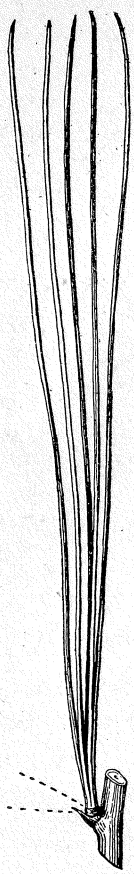


Fig. 123. Leaves of white pine.

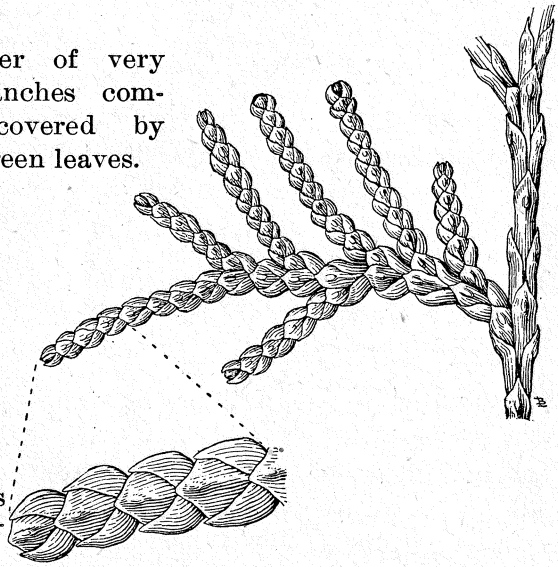


Fig. 124. Branches and green leaves of arbor vitae

[The cut below is printed wrong side up.]

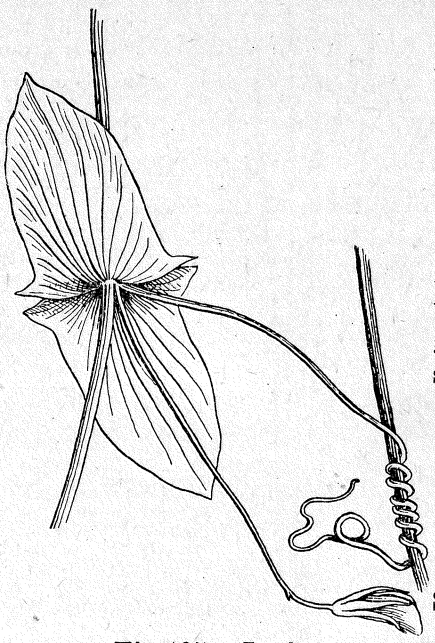


Fig 125. Lathyrus Aphaca, a pea-like plant.

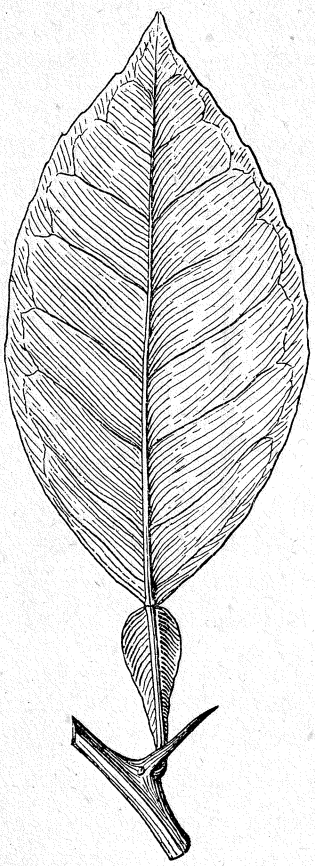


Fig 126. Leaf of a lemon tree.

Some wild lemons bear a leaflet like the blade above, and in place of the upper portion of the broad petiole, appear two other leaflets each with a distinct joint of its own, thus appearing as a compound leaf consisting of three leaflets.

To enable a pupil to determine whether certain portions of a leaf are stipules, petiole or blade, he is to rely on the relative positions they occupy, rather than on their function or general appearance.

In all or very nearly all cases, a bud stands just above the base of a leaf or it may be made to grow there if the stem above is cut off. Leaves are almost always found at what are known as joints (nodes).

Leaves of plants appear as seed leaves, cotyledons, (squash, bean), as bud scales (maple, elm), as bracts (on flower clusters of currants), as storehouses of food (liveforever, century plant), as traps for catching small animals (pitcher plant, bladderwort), as sepals, petals, stamens, pistils of the flower.

The stipules are often small or wanting, but should always be looked for. As has been shown by the above illustrations, some stipules serve for protection as in buds, some serve to hold plants to a support, some are prickles to protect from animals, others are green serving as foliage.

The lower end of the petiole where it joins the stem is usually more or less enlarged, clasping the stem, sometimes even surrounding it. The petiole serves to carry the blade to some extent away from other leaves that it may be properly exposed to light. The petiole is endowed with the ability to turn the blade this way or that, one side towards the light or one edge towards a very strong light.

To describe accurately the forms of leaves a very large number of techinal terms are employed and when one of these words fails to answer the purpose a combination of words is resorted to, for example: a leaf is ovate-lanceolate when it is too broad to be lanceolate and too narrow and pointed to be ovate.

Nearly all the illustrations above represent leaves which are green. Green leaves take in gases and allow gases and moisture to escape. For plants they perform work corresponding somewhat to the work of both lungs and stomach of an air-breathing animal. All stems that are green also act the part of leaves.

Most foliage leaves are thin and flexible, giving them free exposure to light and air. The skeleton or framework of veins or nerves not only supports the more delicate portions, but contains the channels through which the water with other food in solution freely passes.

As objects of beauty, there is great satisfaction in observing leaves at different stages of growth from light green of early spring to dark green in summer, yellow, red, scarlet and brown in autumn.

Why are there so many different kinds of leaves? Why would it not be just as well if all leaves were like those of a sugar maple? Perhaps the designer of nature takes pleasure in beholding a variety. In running water a thin leaf like that of the sugar maple would not long survive. For such a place a leaf needs to be narrow or very stout. Nor

would a thin leaf be able to survive in a desert country. To a certa extent leaves are adapted to their surroundings. The blades of mo leaves droop or the upper part of a blade droops in a way to turn off wat and to face the light.

Most leaves are fragile and are subject to many accidents. Insect eat holes leaving only the ribs and veins, cattle devour them; the wind o spring tears away portions or completely destroys them; the scorchin sun of July withers them; the frosts of autumn kill them and they soon go to the ground, forming a dense carpet to protect seeds and small plants of many kinds during a cold winter. Leaves decay and crumble enriching the earth that it may sustain other plants in years to come. Thus from the time tiny leaves open the bud-scales in spring to the day when they become dark mold, they are very useful things.